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COORDINATED STUDY OF SOLAR-TERRESTRIAL OBSERVATORY (STO)
PAYLOADS ON SPACE STATION

NAG8-488

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Marshall Space Flight Center, Alabama 35812

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SUMMARY

In this investigation we have achieved the following:

1. Reviewed the instruments to be placed on the initial STO at Space Station IOC and developed brief descriptions on each instrument.

2. Reviewed placement of these instruments (i.e. on the manned space station, on the solar polar platform, and on the co-orbiting platform).

3. Developed operational plan for the STO with emphasis on the "campaign mode" definition.

4. Developed international cooperation (i.e. ESA) scenarios for the planning and operation of STO.

I. INTRODUCTION

Since the publication of the final report of the science study group in October, 1984 on the "Solar Terrestrial Observatory", the science goals and objectives are clearly defined and subsequently, a conceptual design and analysis study was carried out by MSFC/NASA and a report was published in March 1982. In 1984 the concept of Space Station began to attract national attention as a possible major goal for national space program development. In order to have a meaningful space station the scientific community has responded favorably to utilization of the space station to perform future space experiments. Thus, the discipline of solar terrestrial physics is making plans for the possible use of the space station to board the solar terrestrial observatory.

Under these circumstances a series of meetings for the STO science study group were held to review the instruments to be placed on the initial STO at space station IOC and the placement of these instruments on the manned space station, polar platform and the co-orbiting platform. In addition, the operational plan and possible international cooperation were also discussed.

A summary of the initial STO instruments is presented in Section II. A brief description of the initial plan for the placement of STO instruments is included in Section III. Finally, in Section IV, we discuss the scenario for the operation of the STO. These results were obtained from the report of the Solar Terrestrial Observatory mini-workshop which was held at MSFC/NASA on June 6, 1985.

II. SUMMARY OF INITIAL STO INSTRUMENTS

The initial Solar Terrestrial Observatory on the IOC space station will primarily consist of instruments which have been developed and flown on previous STS missions. These instruments will have already been modified in order to facilitate the transition from 7 to 14 days which is the normal STS mission to the STO missions with durations of years. The space station should be capable of supporting these instruments since the present instrument interfaces are the accommodation requirements which STO will provide as payload design requirements. Thus, the thermal, power, command and data interfaces should be functionally identical to those interfaces with the shuttle/spacelab.

The STO instruments which are expected to be developed and available by the 1992 time period include atmospheric instruments (interferometers and spectrometers), an airglow and auroral emissions instrument (low light level television), two accelerator systems and an associated beam diagnostic package, a wave injector, a free flying subsatellite, an ejectable probe package (which can include diagnostic probes or chemical release canisters, although there is some uncertainty about its ability to support the chemical release canisters), a tethered subsatellite system, and solar instruments (radiometers, coronagraphs, and telescopes).

The following are brief descriptions of each of the STO instruments which were included in the Solar-Terrestrial Mini-Workshop Report.

Title: Soft X-Ray Telescope (SXRT)

Prepared by: Ron Moore/MSFC

Short Description: The soft X-ray telescope will provide direct images of the solar corona with spatial resolution of about 1 arcsecond. These images will show the global structure of the corona, the location and area of coronal holes, and the presence of even the smallest active regions and flares. The good spatial resolution will show the fine-scale magnetic structure and changes in these phenomena. These observations are essential for monitoring, predicting, and understanding the solar magnetic cycle, coronal heating, solar flares, coronal mass ejections, and the solar wind. These observations complement those of the White Light Coronagraph and Ultra-Violet Coronal Spectrometer; the SXRT will detect active regions and coronal holes near the east limb, thereby giving a week or more of advanced warning for disturbed geomagnetic conditions at Earth. The instrument consists of a grazing incidence collecting mirror with a full-disk film camera at the primary focus, and a secondary relay optic that feeds a CCD camera with a field of view about the size of an average active region.

Instrument Characteristics:

Mass:	170 kg
Volume:	1 cubic meter
Power:	4 amps at 28 Vdc (112 watts)
Data rate:	Digital: 100 kbps
	Film: 1000 frames
	H-alpha TV: 4.2 MHz
Pointing:	Direction: Sun-centered
	Accuracy: 60 arcsec
	Drift: 0.1 degree/hour
	Jitter: 5 arcsec peak to peak at 0.02 to 0.5 Hz

General Comments:

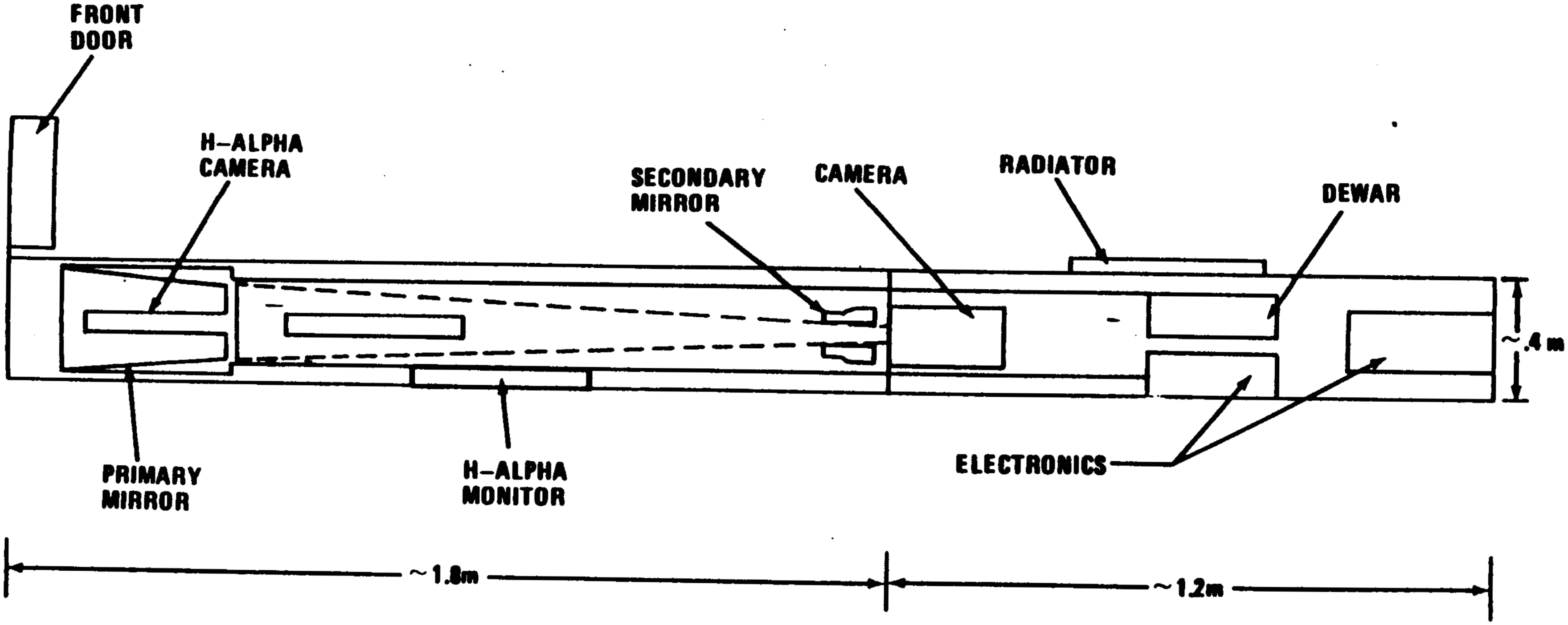
Early versions of this instrument have flown successfully of rockets. Improved versions are planned to fly on rockets and on SPARTAN.

On STO, images from the H-alpha camera should be monitored by the crew and by scientists on the ground.

For more information, contact: Dr. John Davis
American Science & Engineering

4034-85

LAYOUT OF SMALL SOLAR X-RAY TELESCOPE



Title: Solar Ultraviolet Spectral Irradiance Monitor (SUSIM)

Prepared by: Ron Moore/MSFC

Short Description: SUSIM measures the ultraviolet flux from the entire Sun with high absolute accuracy over the wavelength range 120 to 400 nm with a resolution of 0.1 nm. SUSIM consists of two identical double-dispersion scanning spectrometers with 5 photodiodes, 2 photon counters, and a deuterium lamp calibration source, all sealed in a canister pressurized to 1.1 atmosphere of argon. One spectrometer is used almost continuously during sunlight; the other is used once per day as a calibration check. The observations will yield improved absolute measurements of the ultraviolet solar fluxes, provide an accurate reference for studies of variability of the solar fluxes on the time scales of the solar cycle and longer, and measure shorter term changes as well. These measurements complement the ACR measurements of the total solar irradiance. The data will be used to study the physical behavior of the Sun and the Earth's atmosphere, weather, and climate.

Instrument Characteristics:

Mass:	135 kg
Volume:	0.5 cubic meters
Power:	700 watts
Data rate:	0.5 kbps
Pointing:	Direction: Sun
	Accuracy: 5 arc minute
	Scanning range: 0.5 degree

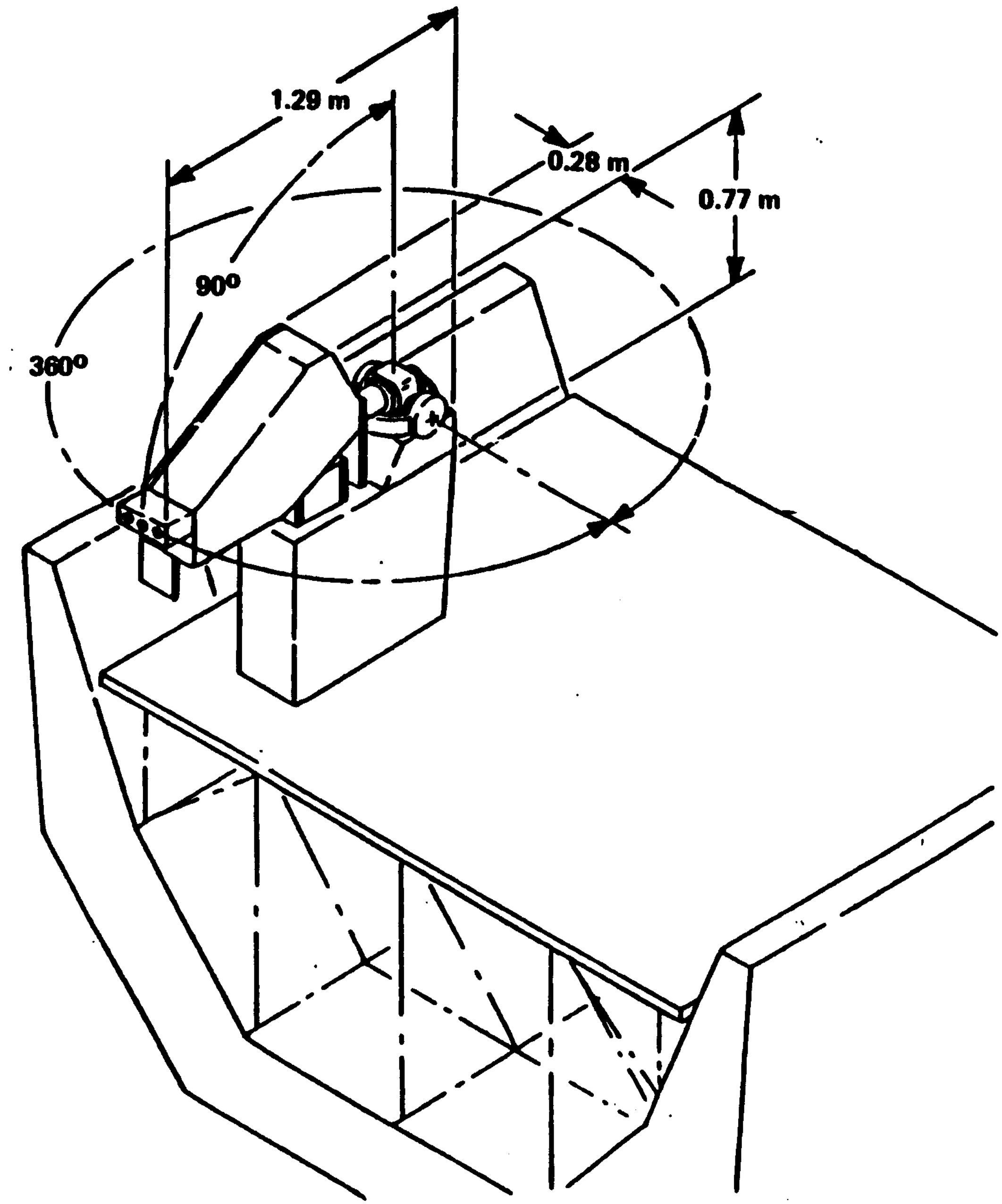
General Comments:

SUSIM will fly on Spacelab 2 and on Sunlab.

For more information, contact: Dr. Guenter Brueckner
Naval Research Laboratory

4035-86

PALLET MOUNTED SOLAR ULTRAVIOLET SPECTRAL IRRADIANCE MONITOR



Title: White Light Coronagraph (WLC) and Ultra-Violet Coronal Spectrometer (UVCS)

Prepared by: Ron Moore/MSFC

Short Description: The WLC and UVCS together reveal the corona and the roots of the solar wind from 1.5 to 6 solar radii from sun center. The WLC measures the plasma density and spatial structure of the corona and coronal mass ejections at a resolution of about 20 arcseconds. The UVCS in combination with the WLC measures the temperature and radial outflow speed of the coronal plasma. These instruments will detect mass ejections from active regions and high speed solar wind streams from coronal holes a few days before the source regions rotate onto the face of the Sun, thus giving a week or more of advanced warning for disturbed geomagnetic conditions at Earth.

Instrument Characteristics:

Mass:	250 kg	
Volume:	3 cubic meters	
Power:	100 watts	
Data rate:	100 kbps	
Pointing:	Direction:	Sun center
	Accuracy:	better than 10 arcseconds

General Comments:

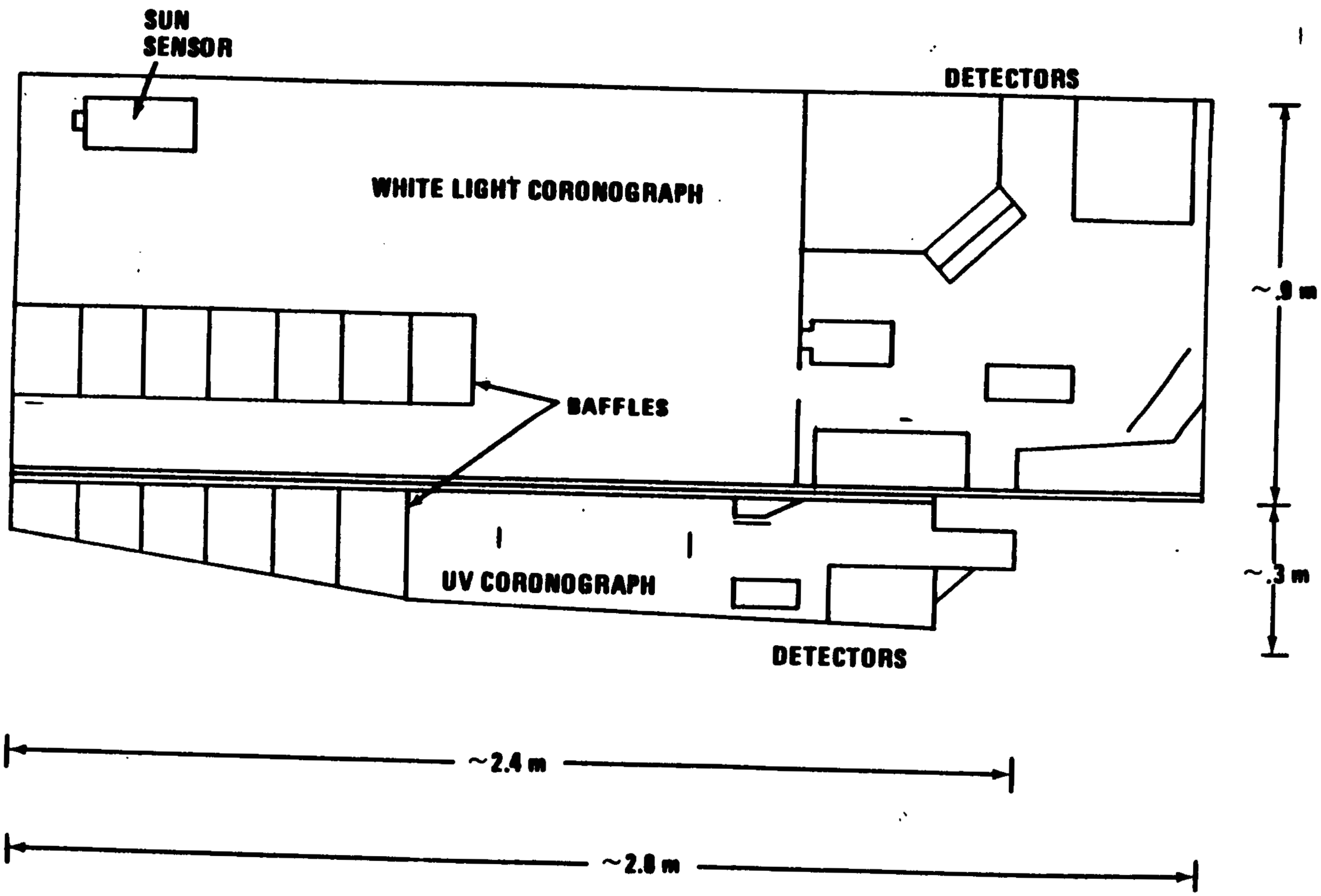
Early versions of this instrument have flown successfully on rockets. Improved versions are planned to fly on SPARTAN and on SOHO.

On STO, images from the WLC should be monitored by the crew and by scientists on the ground.

For more information, contact: Dr. John Kohl
Smithsonian Astrophysical Observatory

Dr. Richard Munro
High Altitude Observatory

4038-85



WHITE LIGHT CORONOGRAPH AND UV CORONAL SPECTROMETER

Title: High Resolution Telescope and Spectrograph (HRTS)

Prepared by: Ron Moore/MSFC

Short Description: The major objectives of HRTS are (1) the investigation of the energy balance and mass balance of the temperature minimum, chromosphere, transition zone, and corona in quiet regions on the Sun as well as in plages, flares, and sunspots; (2) the investigation of the velocity field of the lower corona to study the origin of the solar wind; (3) the investigation of preflare and flare phenomena. The HRTS instrument consists of a telescope, an ultraviolet spectrograph, and ultraviolet spectroheliograph, and an H-alpha slit display system, all housed in a thermal control canister mounted on an instrument pointing system.

Instrument Characteristics:

Mass:	330 kg
Volume:	2.5 cubic meters
Power:	240 watts at 28 Vdc
Data rate:	Digital· 3.2 kbps
	Film: 1000 frames
	H-alpha TV: 4.2 MHz
Pointing:	Direction: Sun
	Accuracy: 60 arcsec
	Stability: 1 arcsec

General Comments:

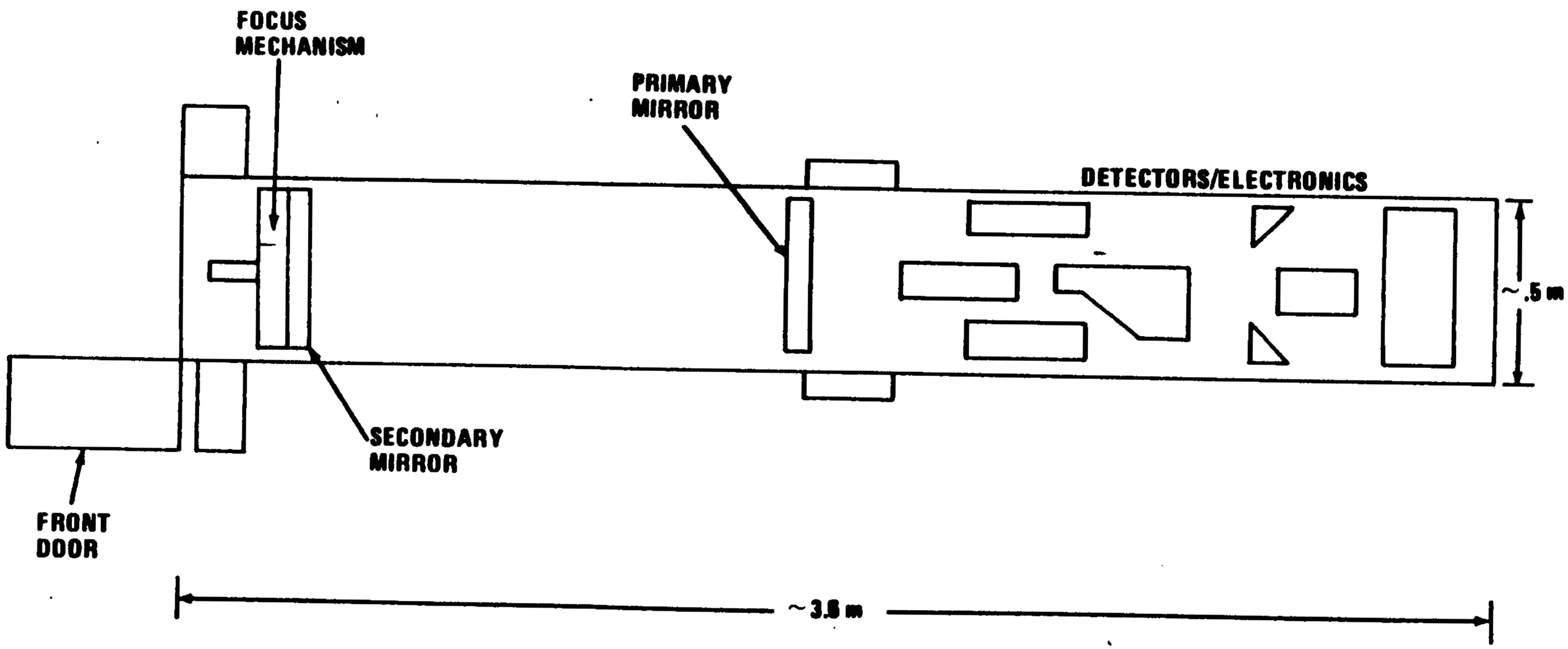
Early versions of this instrument have flown successfully on rockets. Improved versions are planned to fly on Spacelab 2 and Sunlab.

On STO, images from the H-alpha camera should be monitored by the crew and by scientists on the ground.

For more information, contact: Dr. Guenter Brueckner
Naval Research Laboratory

4037–85

HIGH RESOLUTION TELESCOPE AND SPECTROMETER



Title: Active Cavity Radiometer (ACR)

Prepared by: Ron Moore/MSFC

Short Description: The ACR measures the total solar irradiance to determine the magnitude and direction of variations in the total solar radiative output. The ACR is an electrically self-calibrating cavity pyroheliometer capable of measuring the total solar irradiance with an absolute accuracy better than 0.2% and capable of detecting changes in the total irradiance smaller than 0.001%. The data will be used to study the physical behavior of the Sun and the Earth's climate.

Instrument Characteristics:

Mass:	20 kg	
Volume:	0.3 cubic meters	
Power:	15 watts	
Data rate:	0.2 kbps	
Pointing:	Direction:	Sun center
	Accuracy:	better than 2 degrees

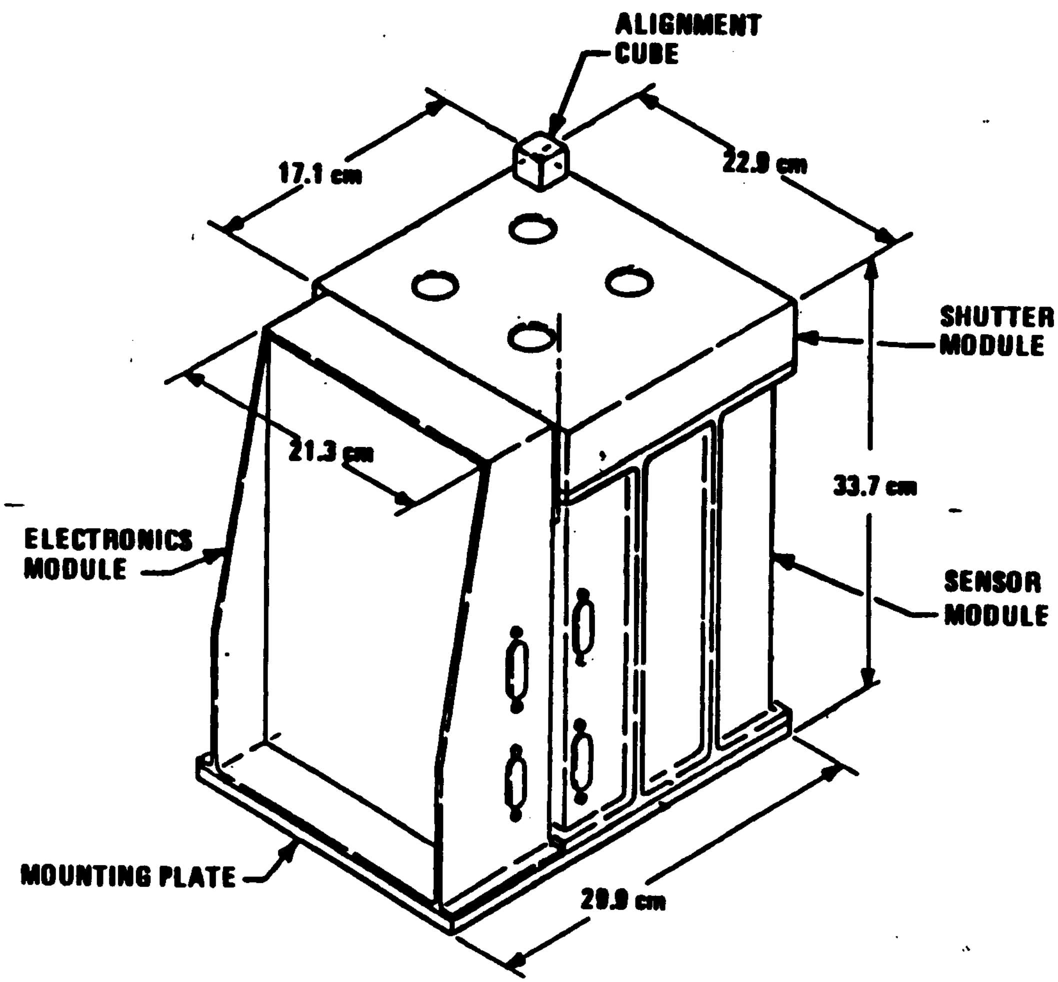
General Comments:

The ACR has flown successfully on the Solar Maximum Mission and on STS Missions.

For more information, contact: Dr. Richard Willson
Jet Propulsion Laboratory

4036–85

ACTIVE CAVITY RADIOMETER



Title: Waves in Space Plasmas: WISP

Prepared by: William W. L. Taylor/TRW

Short Description: WISP utilizes powerful radio transmitters and sensitive receivers to probe the secrets of the magnetosphere, ionosphere and atmosphere. The scientific objective is to achieve a better understanding of the physical processes occurring in these regions. For example, audio frequency radio waves will be radiated from the long WISP antenna, will travel to the outer reaches of the magnetosphere, and will interact with Van Allen belt particles, releasing some of their energy which amplifies the waves. Study of this interaction will give us a better understanding of a major magnetospheric process, wave-particle interactions. Radio waves from WISP at higher frequencies (AM radio and beyond) will be reflected by the ionosphere and will, for example, advance our understanding of bubbles in the equatorial ionosphere which affect satellite communications.

Instrument Characteristics:

Mass:	1200 kg
Volume:	6 cubic meters
Power:	6 kW initially (evolving to 50+ kW)
Data rate:	10 Mbs

General Comments:

Heritage is from Spacelab instrument to fly in 1990 and 1992 on SPL 1 and 2.

No scanning is required.

The antenna will be extendable and retractable, but once extended, does not have to be retracted until the end of the WISP mission.

It is expected that a fixed location for the antenna will be adequate for the science on STO.

Antenna mounting must be such that its axis is in the velocity vector or the zenith/nadir vector.

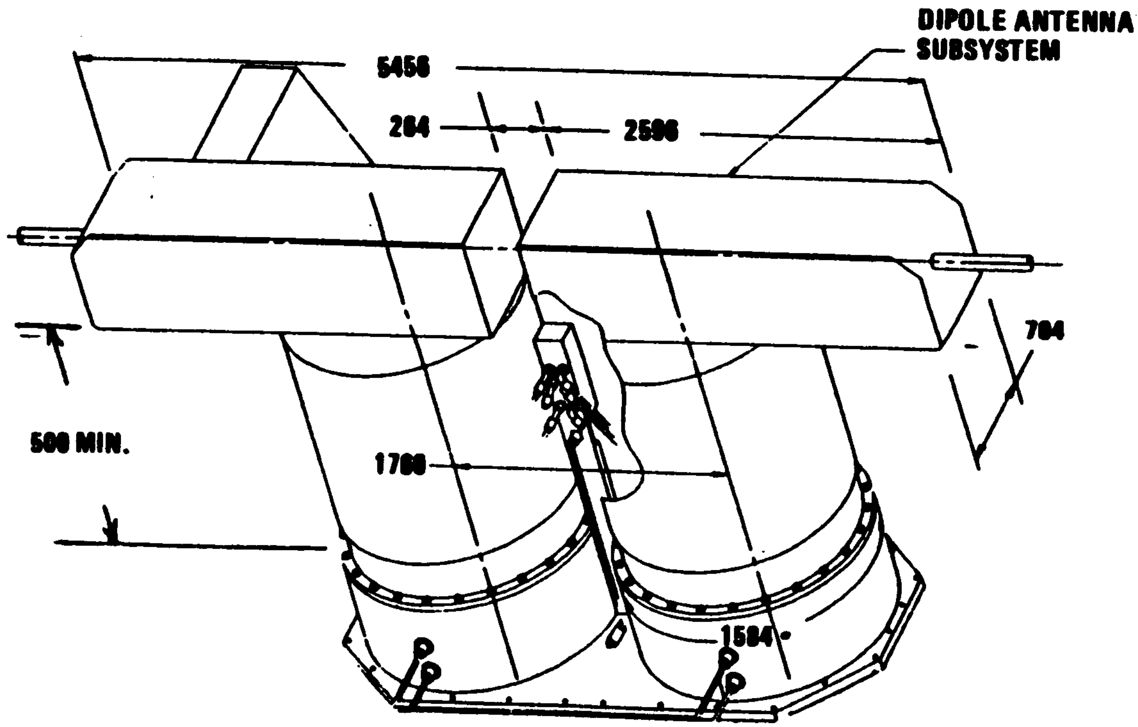
Antenna length may be up to 1000 meters (desired) tip-to-tip; (300 meters tip-to-tip initially).

WISP must also be able to connect to the conducting tether wire for an antenna.

Source of Information: WISP development for SPL.

For more information, contact: Robert W. Fredricks or
William W. L. Taylor
TRW, R1/1170
One Space Park
Redondo Beach, CA 90278
213-536-2017

WAVES IN SPACE PLASMA INSTRUMENTS INCLUDE 13 BOXES THAT ARE COLD PLATE SIZE PLUS



NOTE: DIMENSIONS IN mm

Title: Space Experiments with Particle Accelerators: SEPAC

Prepared by: Bill Roberts/NASA/MSFC

Short Description: The SEPAC instruments consist of an electron accelerator, a plasma accelerator, a neutral gas (N_2) release device, particle and field diagnostic instruments, and a low light level television system. These instruments are used to accomplish multiple experiments: to study beam-particle interactions and other plasma processes; as probes to investigate magnetospheric processes; and as perturbation devices to study energy coupling mechanisms in the magnetosphere, ionosphere, and upper atmosphere.

Instrument Characteristics:

Mass:	600 kg
Volume:	3 cubic meters
Power:	1.5 kW
Date rate:	512 Kbs plus 1 analog and 1 video

General Comments:

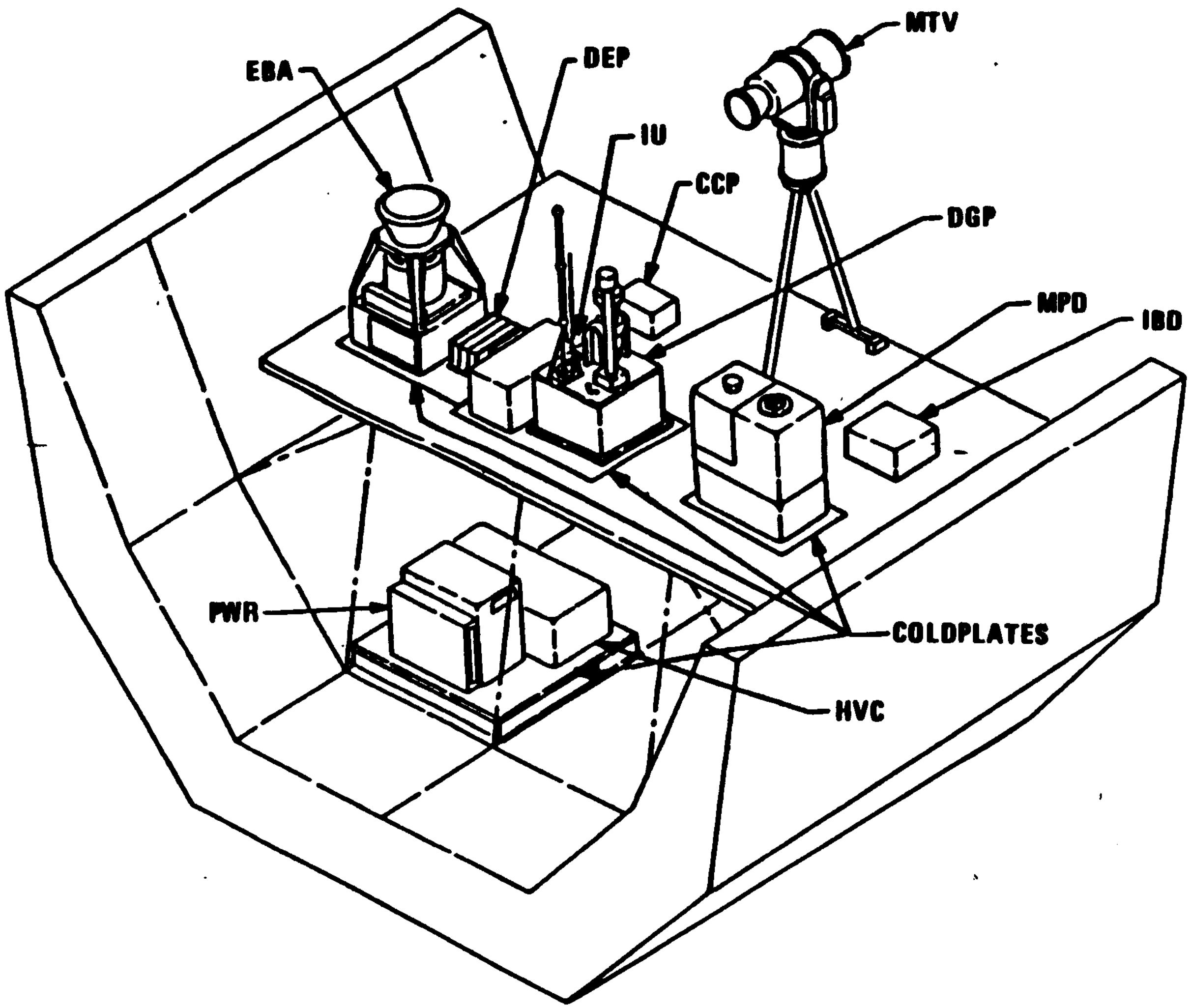
Heritage is from Spacelab instrument flown in 1983 on Spacelab I, and scheduled for reflight on the Earth Observation Mission (1986) and Space Plasma Lab (1990, 1992).

No scanning is required. SEPAC television provides its own pointing system. SEPAC electron accelerator provides deflection coils for beam pointing.

For more information contact: Bill Roberts
PS02
NASA/MSFC
Huntsville, AL 35812
(205) 453-3430

4040-85

SEPAC PALLET—MOUNTED HARDWARE



Title: Theoretical and Experimental Beam Plasma Physics: TEBPP

Prepared by: Bill Roberts/NASA/MSFC

Short Description: The TEBPP consists of a package of five instruments to measure electric and magnetic fields, plasma density and temperature, neutral density, photometric emissions, and energetic particle spectra during firings of the particle injector (SEPAC) electron beam The package is deployed on a maneuverable boom (or RMS) and is used to measure beam characteristics and induced perturbations in the near field (<10 m) and mid field (10 m - 100 m) along the electron beam. The TEBPP package will be designed to investigate induced oscillations and induced electromagnetic mode waves, neutral and ion density and temperature effects, and beam characteristics as a function of axial distance.

Instrument Characteristics:

Mass:	36 kgm
Volume:	.1 cubic meters
Power:	.07 kW
Data rate:	4 Mbs

General Comments:

Heritage is from instrument package being designed for flight on Space Plasma Lab (1992).

TEBPP package will be designed to be deployed and maneuvered at the end of an RMS.

The 4 Mbs data rate may be sampled to accommodate lower (64 kbs) data rate restrictions.

Instruments may also be useful for other active experiments or for monitoring ambient environment of the Space Station.

Source of Information: PDR documents

For more information contact: Bill Roberts
PS02
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(205) 453-3430

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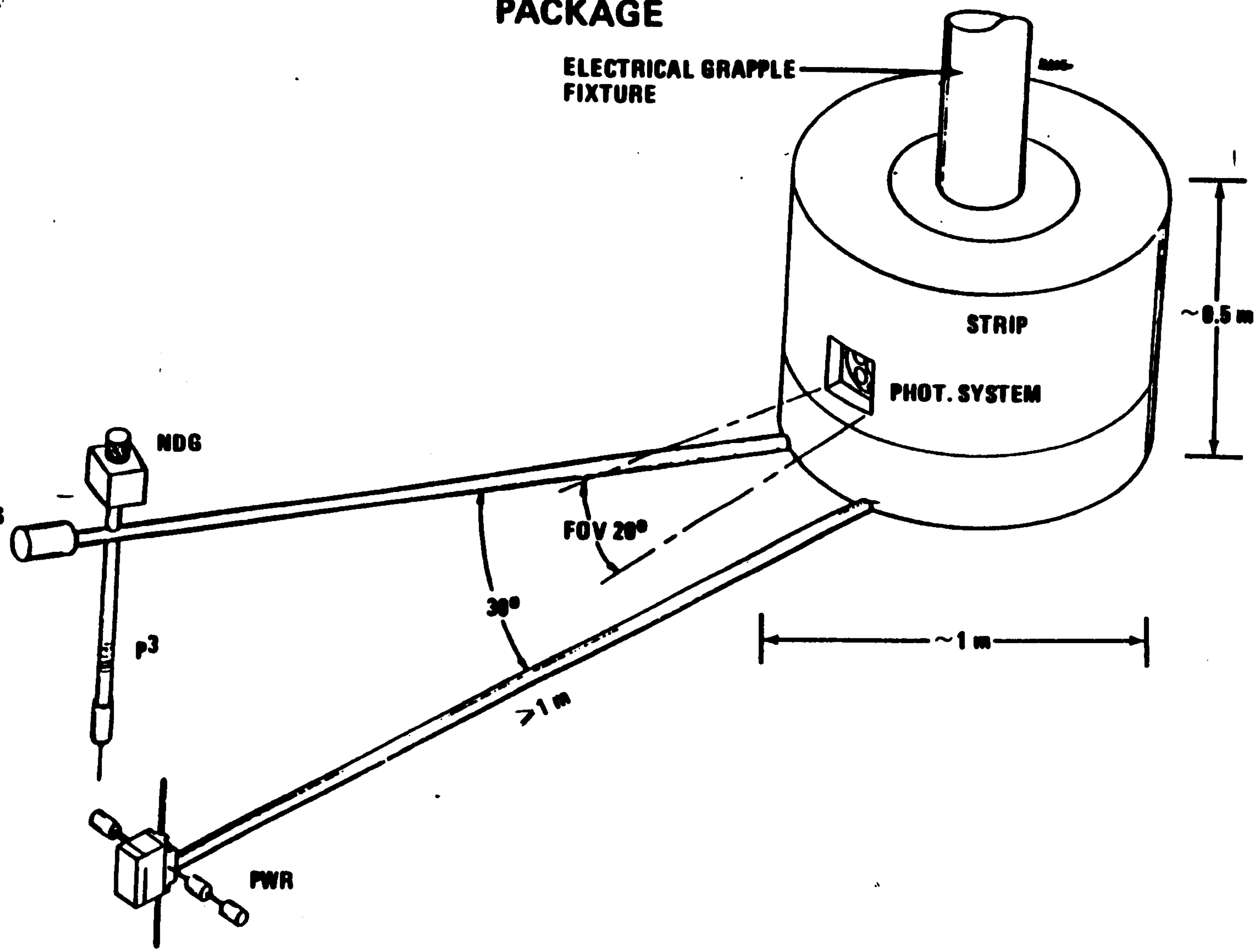
THEORETICAL AND EXPERIMENTAL BEAM PLASMA PHYSICS PACKAGE



Title: Recoverable Plasma Diagnostics Package: RPDP

Prepared by: Bill Roberts/NASA/MSFC

Short Description: The RPDP is an ejectable and recoverable satellite with flight and ground support systems so that it can be utilized in three modes: attached to an RMS; tethered; or as a subsatellite. The satellite is well instrumented with particle and field diagnostic as well as optical sensors to: investigate the dynamics of the natural environment or ejected perturbations from particle beams; measure the characteristics and propagation of electrostatic and electromagnetic waves; study wave particle interactions; study natural properties of the magnetosphere, ionosphere, and upper atmosphere.

Instrument Characteristics:

Mass:	580 kg (540 kg satellite, 40 kgm Space Station equipment)
Volume:	1.5 cubic meters
Power:	.8 kW (when operated on RMS) .2 kW as a subsatellite
Data rate:	1.25 Mbs

General Comments:

Early versions flown on OSS-1 (1982) and Spacelab II missions (1985). The RPDP is scheduled for flight on Space Plasma Lab (1990, 1992).

Plan for the RPDP to free fly in a "station keeping" mode with Space Station, so that periodic pickup and repositioning will be done by the STS or OMV. The RPDP has no maneuvering capability.

Range from Space Station should be within 200 km for active experiments (although the RPDP could drift up to one orbit differentially).

Data routed through Space Station. (Ground stations can be used 200 km range).

Source of Information: RPDP fact sheet

For more information contact: Bill Roberts
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NASA/MSFC
Huntsville, AL 35812
(205) 453-3430

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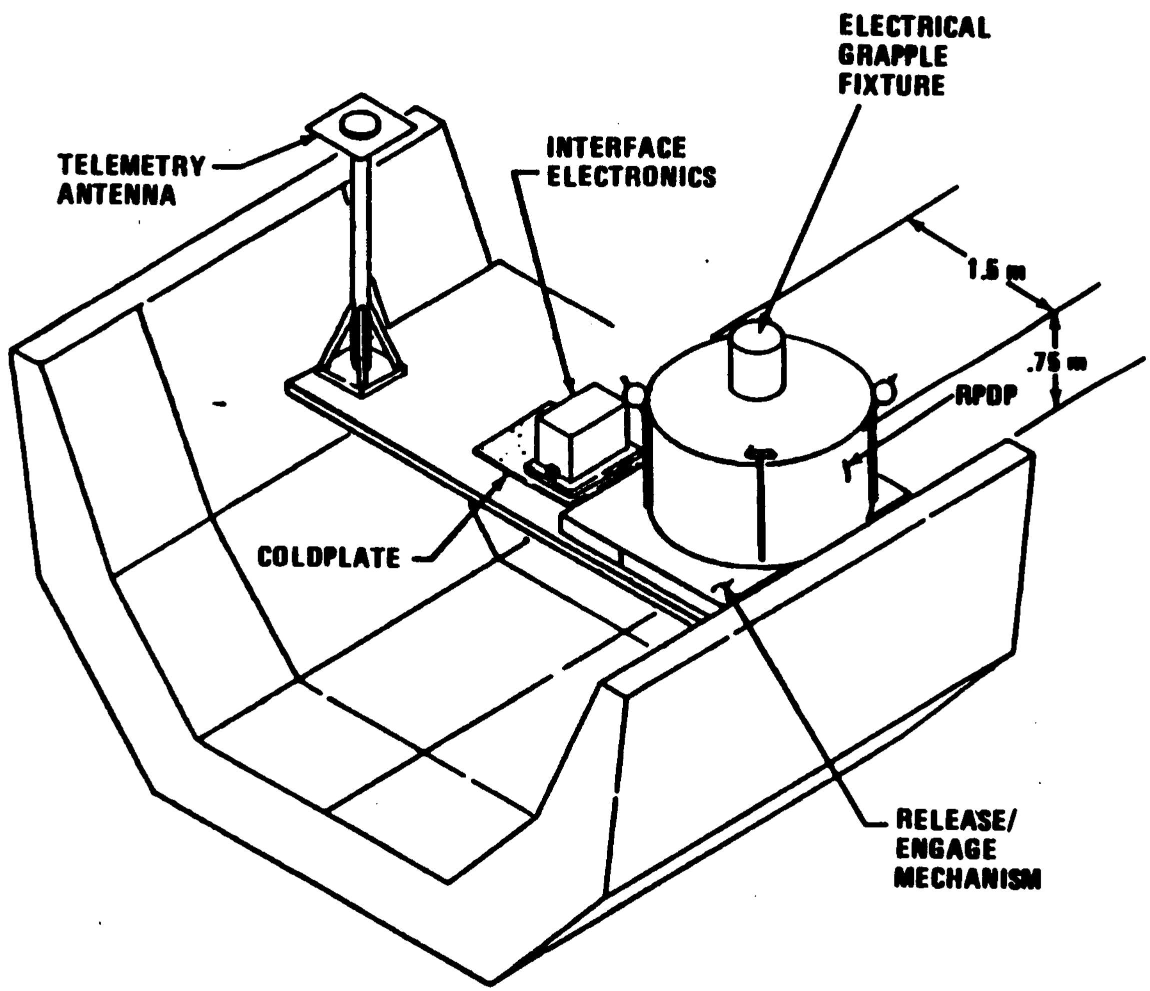
RECOVERABLE PLASMA DIAGNOSTICS PACKAGE ASSEMBLY MOUNTED ON A PALLET



Title: Electrodynamic Tether

Prepared by: Bill Roberts/NASA/MSFC

Short Description: The Electrodynamic Tether consists of a satellite deployed to a distance of 20 km by an electrically conducting tether. The Space Station hardware consists of a 12 meter deployment boom, satellite cradle, tether reel and motor, and other tether support systems. The Electrodynamic Tether will be used to perform a variety of wave experiments by exciting a wide spectrum of low frequency waves in the ionospheric plasma. The system can also be used to artifically generate and study field aligned currents and associated plasma effects. Hydromagnetic waves generated by the passage of the system through the space plasma are of particular interest in space plasma research.

Instrument Characteristics:

Mass:	2600 kgm (includes 500 kgm for satellite)
Volume:	8 cubic meters (includes 1 cubic meter for satellite)
Power:	1.6 kW (1.5 kW for peak operation of the deployer operating for up to 10 hours for each deployment)
Data rate:	64 Kbs
Campaign period:	6 days

General Comments:

Early versions of the Electrodynamic Tether will be flown on STS missions beginning in the late 1980s. It is expected that the tether will also be flown in the "atmospheric mode" before 1990, where a 100 km tether will be deployed down (earthward from the STS).

The tether mission will be a part of the STO "campaign mode" wherein the tether is deployed for one week per month (average), and then retrieved.

Servicing of the satellite is expected to be required after every retrieval.

Items to be serviced include the satellite batteries and gas for satellite thrusters. The tether material should be routinely inspected for material degradation.

Data will be through Space Station.

Source of Information: TSS Project Documents

For more information contact: Bill Roberts
PS02
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Huntsville, AL 35812
(205) 453-3430

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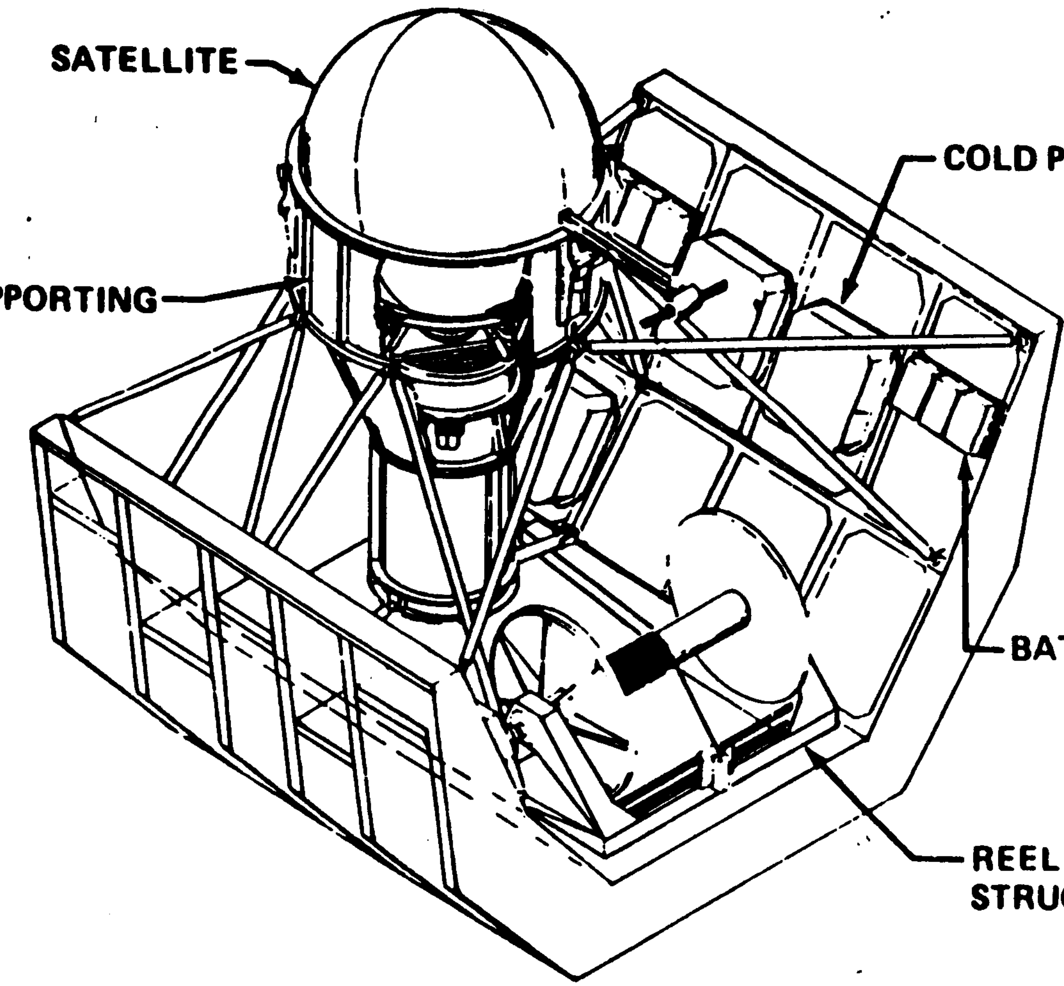
PALLET MOUNTED TETHERED SATELLITE SYSTEM

TSS CONFIGURATION



Title: Imaging Spectrometric Observatory: ISO

Prepared by: Bill Roberts/NASA/MSFC

Short Description: The objectives of this instrument are to measure the spectral signatures of a large range of minor constituents, metastable, and excited species of both atomic and molecular ions, and neutrals in the atmosphere (from the stratosphere to the upper thermosphere). The instrument is composed of five identical spectrometers, each restricted to a given spectral range between 20 and 1200 nanometers designed for high speed operation as an imaging device. Each module is an imaging scanning spectrometer with coincident 0.5x0.007 degree field-of-view.

Instrument Characteristics:

Mass:	250 kgm
Volume:	1 cubic meter
Power:	.2 kW
Data rate:	2.0 Mbs peak, 125 Kbs average

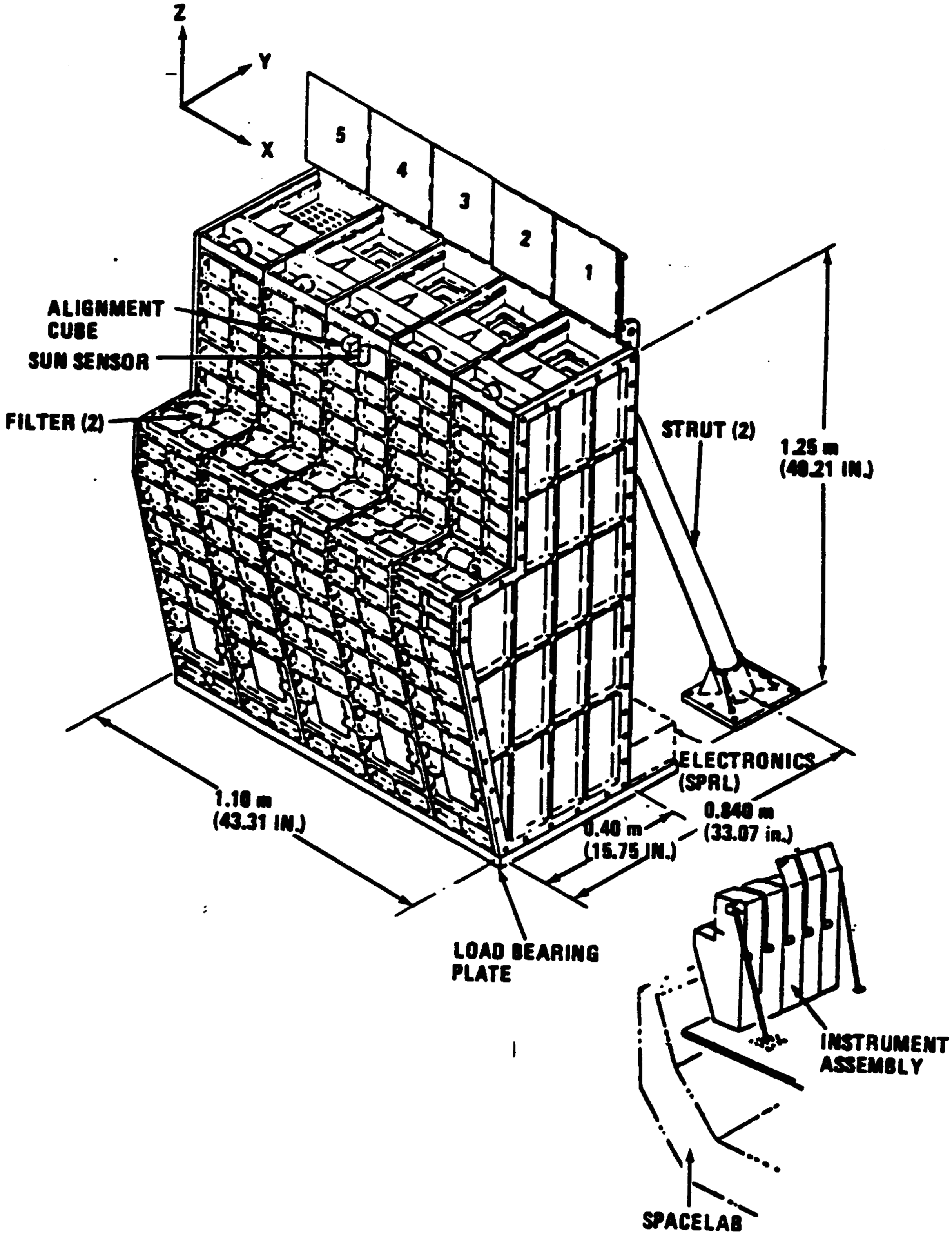
General Comments:

Heritage is from Spacelab I flown in 1983 with reflights scheduled on Earth Observation Missions (1986, 1988). Instrument is presently fixed-mounted with pointing at nadir or limb using mirror system. Future flights desire mounting on a pointing system. Instrument should be mounted to provide a clear field-of-view from Earth nadir to limb.

Source of Information: ISO fact sheet

For more information contact: Bill Roberts
PS02
NASA/MSFC
Huntsville, AL 35812

IMAGING SPECTROMETRIC OBSERVATORY



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Title: Atmospheric Emission Photometric Imaging: AEPI

Prepared by: Bill Roberts/NASA/MSFC

Short Description: The AEPI consists of a dual channel, low light level video system with a filter wheel to isolate the emissions of interest, mounted on a stabilized, two-axis gimbal system for pointing and control. The objectives are to produce images of various atmospheric emissions to: investigate ionospheric transport processes; observe induced emissions from artificial particle injection; measure electron impact cross sections of atmospheric species; study natural aurora at high spatial and temporal resolutions and in the ultraviolet.

Instrument Characteristics:

Mass:	200 kg
Volume:	1 cubic meter
Power:	.35 kW
Data rate:	300 Kbs plus 1 video channel

General Comments:

Heritage is from Spacelab I flown in 1983 and reflights scheduled on Earth Observation Missions (1986) and Space Plasma Lab (1992).

The instrument provides its own pointing mount.

Instrument requires a clear field-of-view from Earth nadir to limb, in all directions.

Source of Information: AEPI fact sheet

For more information contact: Bill Roberts
PS02
NASA/MSFC
Huntsville, AL 35812

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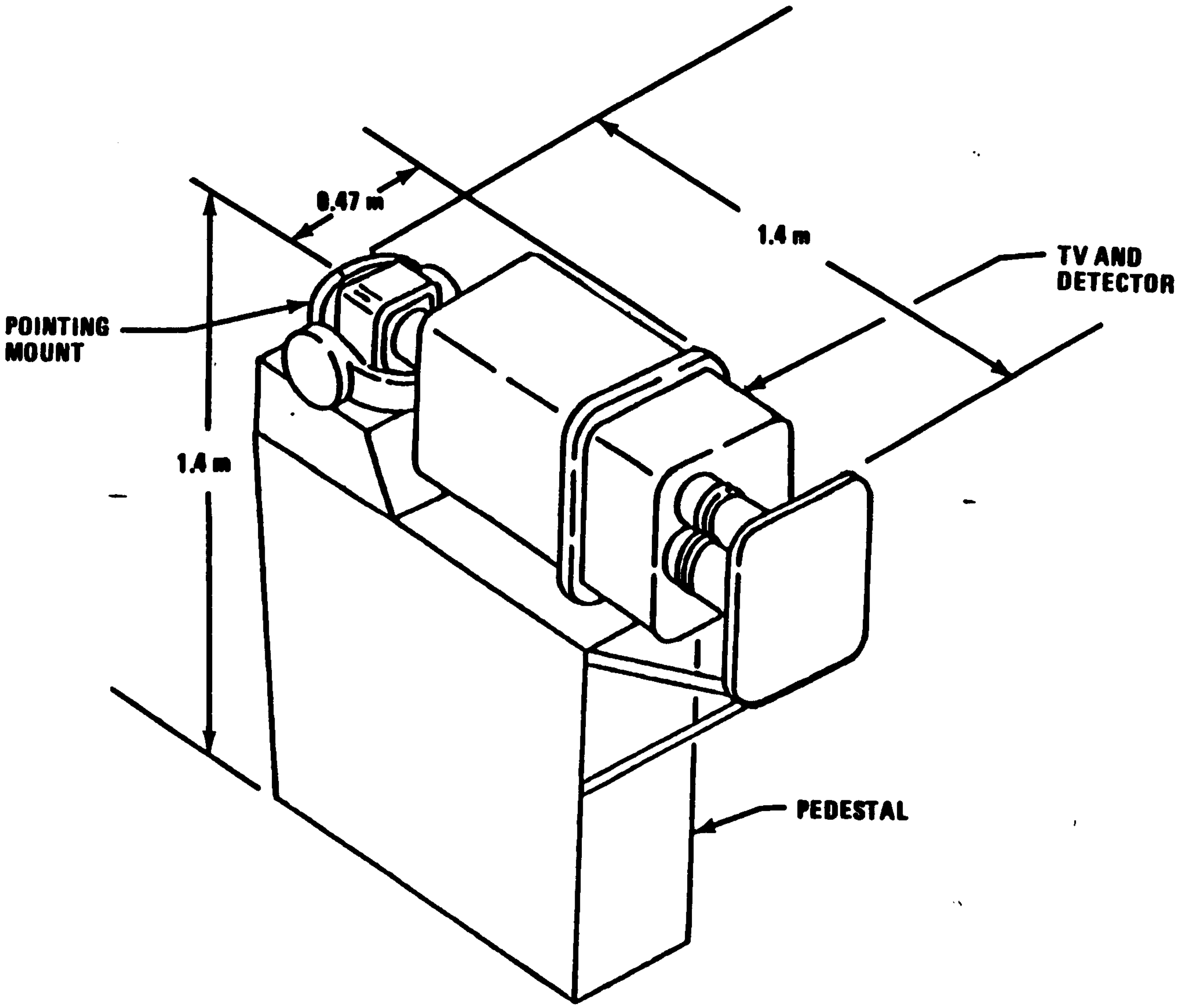
ATMOSPHERIC EMISSIONS PHOTOMETRIC IMAGER



Title: Magnetospheric Multiprobes: MMP/Chemsat

Prepared by: Jim Burch/SwRI

Short Description: The Multiprobes (MMP) are a set of ejectable, self-contained, limited-lifetime free flyers which are designed to make plasma diagnostic measurements at multiple locations within telemetry range of the Space Station's co-orbiting platform and polar platform. When configured as Chemsats, one or more MMP's will conduct chemical releases as tracers or modifiers of the local plasma and field environment, while diagnostic measurements are made from other MMP's and from the nearby platform. The probes will be battery powered and will have lifetimes of a few days to several weeks. Up to 12 probes would be placed on the co-orbiting platform and the polar platform every six months and two years respectively for use in the campaign mode of operation.

Instrument Characteristics:

Mass:	Carrier and ejection mechanism for each probe: 160 kg; individual probe: 160 kg
Dimensions:	Carrier and ejection mechanism for each probe: 1.1 m diameter; 1.3 m height. Individual probe: 0.9 m diameter; 0.5 m height.
Power:	1000 Watts on platform 500 Watts on each probe (from self-contained battery)
Data Rate:	400 kb/s per probe

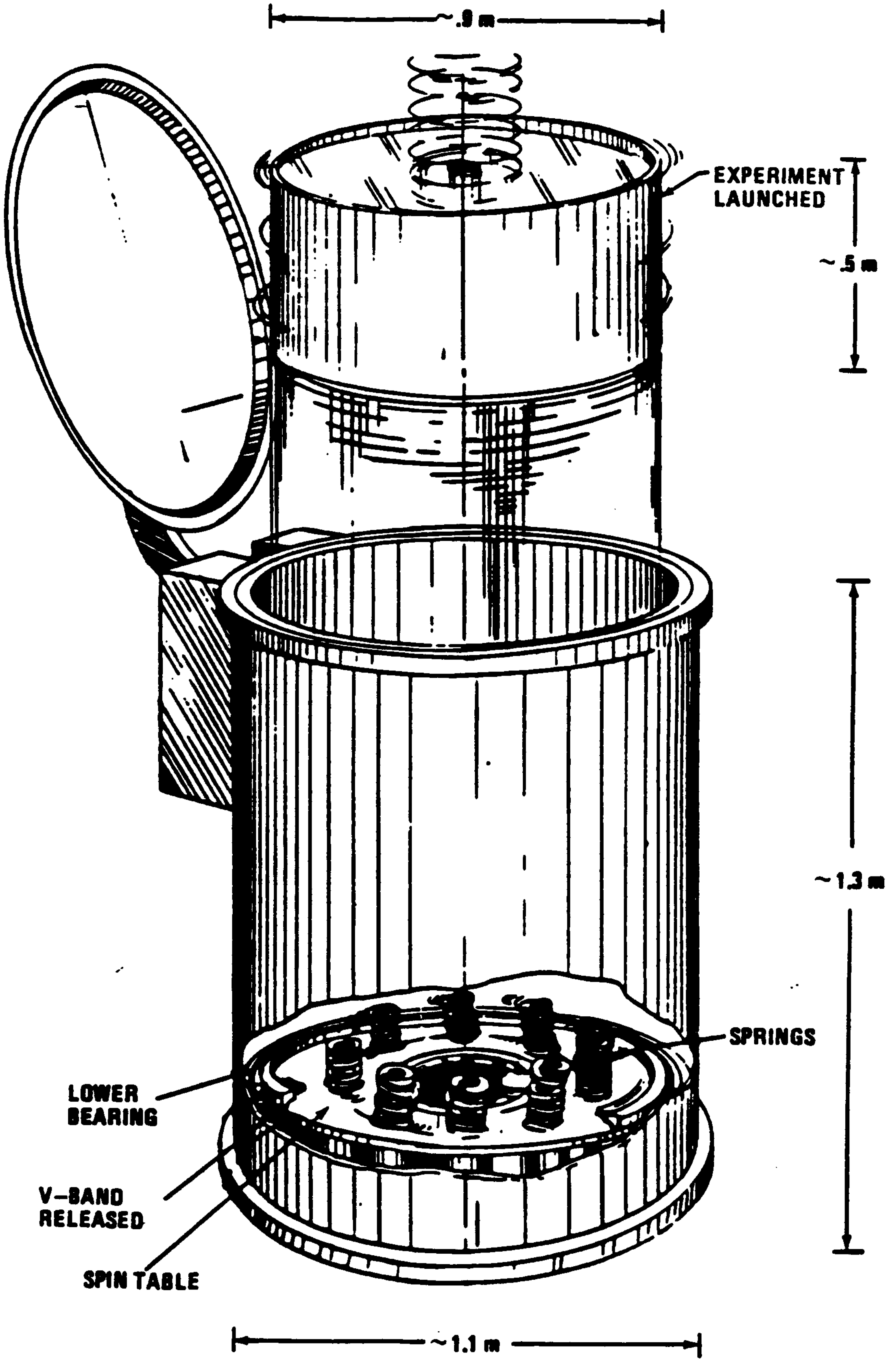
General Comments:

The MMP system is being developed by Wallops Flight Center. A single-probe Shuttle mission is tentatively scheduled for late 1987 and a four-probe mission for late 1989.

Data routed through Space Station Platforms.

For more information, contact: Dr. Jim Burch
Southwest Research Institute
P. O. Drawer 28510
San Antonio, TX 78284

EJECTION OF MULTIPROBE FROM CARRIER



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Title: Wide Angle Michelson Doppler Imaging Interferometer: WAMDII

Prepared by: Bill Roberts/NASA/MSFC

Short Description: The WAMDII is a specialized type of optical Michelson interferometer working at sufficiently long path difference to measure Doppler shifts and to infer Doppler line widths of naturally occurring upper atmospheric Gaussian line emissions. The instrument is intended to measure vertical profiles of atmospheric winds and temperatures within the altitude range of 85 km to 300 km. The WAMDII consists of a Michelson interferometer followed by a camera lens and an 85 x 106 CCD photodiode array. Narrow band filters in a filter wheel are used to isolate individual line emissions and the lens forms an image of the emitting region on the CCD array.

Instrument Characteristics:

Mass:	100 kgm
Volume:	.4 cubic meters
Power:	.2 kW
Data rate:	324 kbs

General Comments:

Heritage is from an instrument being designed for flight on a future STS mission.

Instrument requires accurate knowledge of the angle between the look-direction and the spacecraft velocity vector to an accuracy of 0.03 degrees.

Field-of-view is rectangular of dimensions 6.0° x 7.5°.

Requires pointing accuracy of 0.5°.

Other targets include auroral forms, airglow irregularities, chemical releases, particle beam injections, and emissions stimulated by wave injections.

Source of Information: Experiment Requirements Document

For more information contact: Bill Roberts
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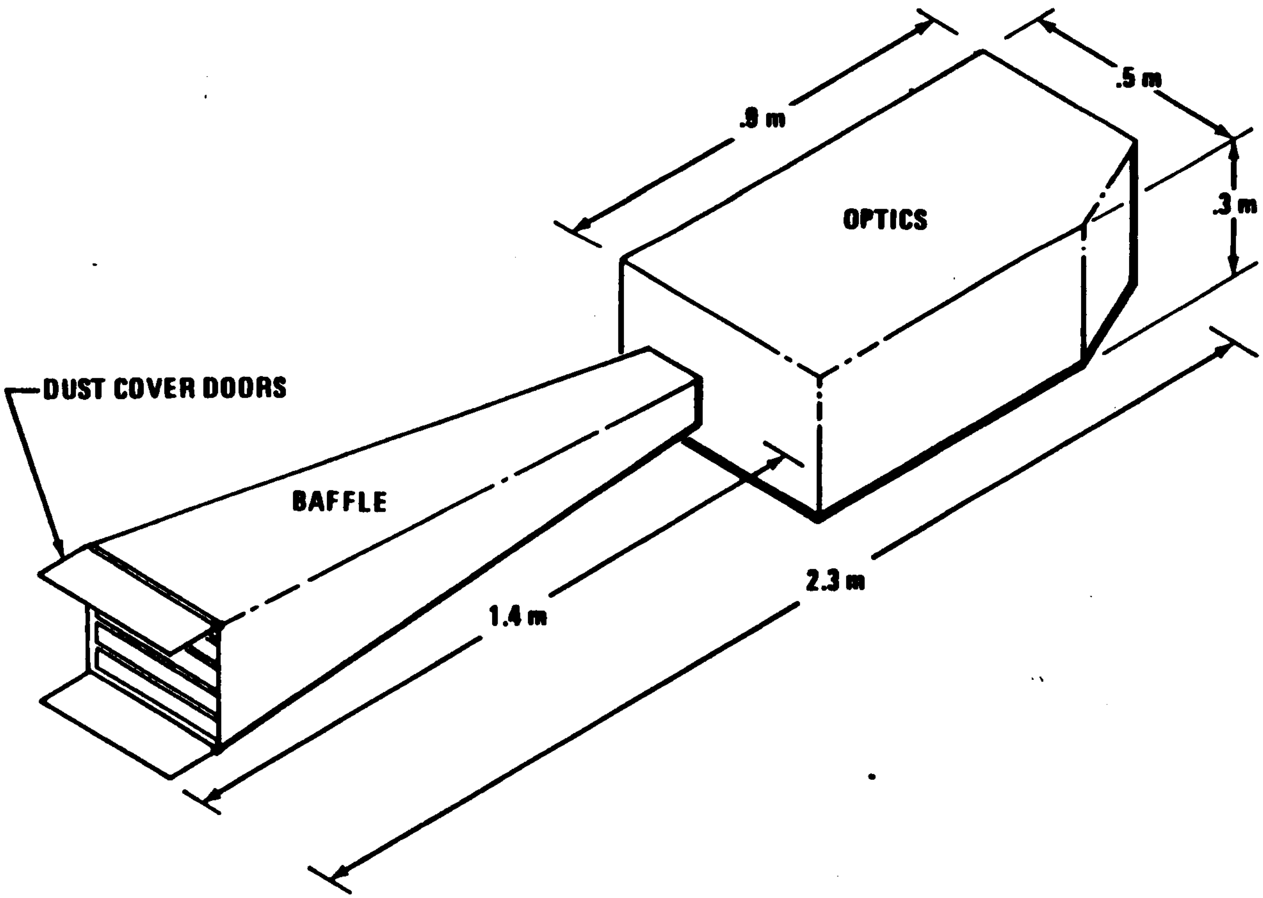
4047–85

WIDE ANGLE DOPPLER IMAGING INTERFEROMETER OPTICS



Title: Vehicle Charging and Potential: VCAP

Prepared by: William T. Roberts/MSFC

Short Description: The instrumentation of the VCAP includes a small electron accelerator capable of operating in a pulsed mode with firing pulses ranging from 600 nanoseconds to 107 seconds (100 milliamps at 1000 volts), a spherical retarding potential analyser - Langmuir probe, and charge current probes. This instrumentation will support studies of beam plasma interactions and the electrical charging of the spacecraft. Active experiments may also be performed to investigate the fundamental processes of artificial aurora and ionospheric perturbations. In addition by firing the beam up the geomagnetic field lines of force (away from the Earth) investigations of parallel electric fields may be performed.

Instrument Characteristics:

Mass:	100 kilograms
Volume:	.3 cubic meters
Power:	.3 kilowatts
Data rate:	100 Kbps

General Comments:

Instrumentation originally flown on OSS-1 and Spacelab II missions.

The VCAP will be operated during STO campaign modes to support magnetosphere/ionosphere investigations.

Coordinated experiments between the polar platform and the manned Space Station will occasionally be performed.

Coordinated investigations with other polar platform instruments will be performed.

Source of Information: VCAP Information Sheets

For more information, contact: William T. Roberts
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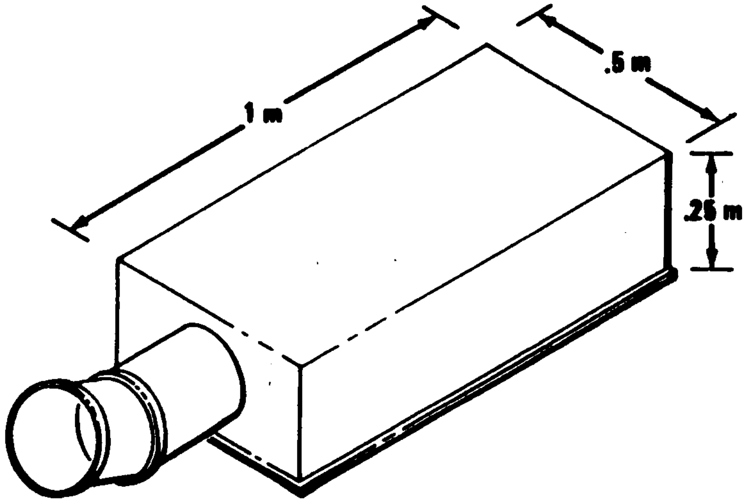
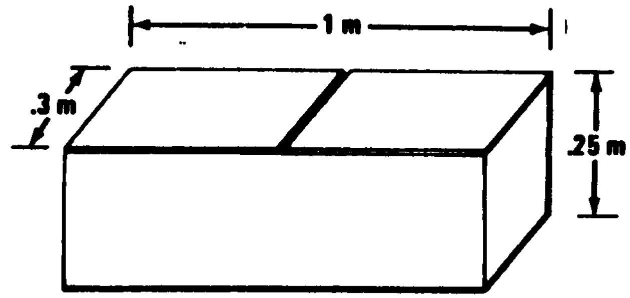
4048–85

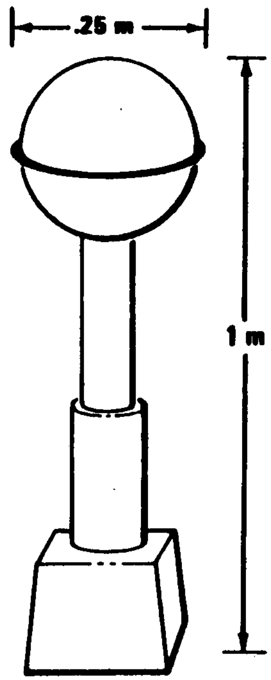
VEHICLE CHARGING AND POTENTIAL EXPERIMENT PACKAGES



FAST PULSE ELECTRON GUN



CHARGE CURRENT PROBE



SPHERICAL PROBE

III. INITIAL PLAN FOR THE PLACEMENT OF STO INSTRUMENTS

Currently plans for the placement of STO instruments on the IOC space station will use each of the space station elements, the manned space station, the polar platform, and the co-orbiting platform. Table I provides a designation of the instrument placement and a summary of the mass, volume, power and data requirements of each of these instruments.

The solar instruments will be placed on the manned space station and will observe the sun 24 hours per day. Particularly, constant attention is needed to obtain continuing information of the total radiative output of the sun (the solar constant). Changes of a fraction of a percent in solar radiation would have a significant effect on the Earth's energy input and thus the long-term climatic conditions. The ultraviolet portion of the solar spectrum has a dramatic effect on the chemistry of the Earth's middle atmosphere. Long-term monitoring of this portion of the solar spectrum will be accomplished by the use of an ultraviolet irradiance monitor. Measurements of coronal changes, soft x-ray emissions and mass ejections will also provide data on solar energetic events which will trigger periodic operations of the Solar Terrestrial Observatory in the campaign mode. These modes of operation will be invoked to study the coupling of active events on the sun into the Earth's environment.

Also on the manned space station will be the large active instruments. These instruments include large electron and plasma accelerators, with associated beam plasma diagnostic monitors, high power wave injectors, and an electrodynamic tether system. The accelerators are used to investigate beam plasma interactions, ionospheric modifications, plasma propagation and ionization, and simulated emissions. These accelerators operate in a pulsed mode with firing duration of about five seconds at low power (<5 kW) ranging to one-tenth of a second at high power (<40 kW). A number of particle and field diagnostic instruments are included to support the assessment of the effects of the beam on the ambient environment, on the space station, and on the beam itself. These instruments include ion spectrometers, electron detectors, wave detectors, neutral particle detectors, photometers, and a low light level imager. One particular group of instruments will be built for mounting on the RMS. These instruments will be moved rapidly along the accelerated beam to measure beam properties and their variations at different positions along the beam. The RMS mounted instruments will require that that crewman, using the space station RMS, pick up the diagnostic package and control its position and operations during selected firings of the accelerators. This package may also have a use for measuring the interactions of the ambient plasma with the space station, and the flow of the plasma around the space station. In addition, the RPDP makes similar measurements at various ranges remote from the space station.

The wave injection instruments are also on the manned space station, and are used for studies of wave-particle interactions, wave propagation, and ionospheric sounding. The instrument radiates energy from a long dipole antenna which is deployed during the operations campaigns and can

SOLAR TERRESTRIAL OBSERVATORY
PROPOSED INITIAL PLACEMENT OF INSTRUMENTS

3770–85

MANNED STATION	MASS	VOLUME	POWER	DATA RATE	COMMENT
CORONOGRAPH	250 KG	3.0 M^3	.1 KW	100 KBPS	
TOTAL IRRADIANCE MONITOR	20 KG	0.03 M^3	.015 KW	.2 KBPS	
UV IRRADIANCE MONITOR	135 KG	0.5 M^3	.7 KW	.5 KBPS	
HRTS	330 KG	2.5 M^3	.25 KW	3.2 KBPS*	* PLUS FILM AND TV
SOFT X–RAY TELESCOPE	170 KG	1.0 M^3	.1 KW	100 KBPS*	*PLUS H–Z TV (MAX)
WAVE INJECTOR	1200 KG	6.0 M^3	25 KW*	10 MBPS	*MAXIMUM POWER WILL GROW
PARTICLE INJECTOR	600 KG	3.0 M^3	1.5 KW	512 KBPS*	*DATA PLUS VIDEO & ANALOG
PLASMA MONITORS	36 KG	0.1 M^3	70 WATTS	4 MBPS	DESIGNED FOR RMS MOUNT
RECOVERABLE PLASMA SATELLITE	580 KG	1.5 M^3	200 WATTS	1.25 MBPS	FREE FLYER
TETHER	2600 KG	8.0 M^3	1.6 KW*	64 KBPS	*PEAK POWER DURING DEPLOY.
TOTAL	5921 KG	26 M^3	30 KW*	17 MBPS*	*PEAK DEMAND

POLAR PLATFORM	MASS	VOLUME	POWER	DATA RATE	COMMENT
IMAGING SPECTROMETERS	250 KG	1.0 M^3	200 WATTS	2.0 MBPS*	*PEAK DATA RATE
PHOTOMETRIC IMAGER	200 KG	1.0 M^3	350 WATTS	300 KBPS*	*DATA PLUS VIDEO
IMAGING INTERFEROMETER	100 KG	0.4 M^3	200 WATTS	324 KBPS	
EJECTABLE PROBES	4000 KG	16.0 M^3	1.0 KW	400 KBPS*	*PER EJECTABLE PROBE
PARTICLE INJECTOR	100 KG	.3 M^3	300 WATTS	100 KBPS	
TOTAL	4650 KG	19 M^3	1050 WATTS	3.2 MBPS*	*PEAK DEMAND

CO–ORBITING PLATFORM	MASS	VOLUME	POWER	DATA RATE	COMMENT
EJECTABLE PROBES	4000 KGM	16.0 M^3	1.0 KW	400 KBPS*	*PER EJECTABLE PROBE

TABLE 1

be retracted at all other times. The antenna length will normally be deployed to 150 meters per element (300 meters tip-to-tip) but may achieve 1000 meters tip-to-tip when fully deployed. This instrument may be used in a high frequency mode to perform soundings to study the propagation of ionospheric disturbances and topside ionospheric structures. The instrument is also used to investigate plasma heating and other perturbations of interest and importance in space plasma physics. Wave experiments are also performed in coordination with the free-flying RPDP.

The final instrument mounted directly on the space station at IOC will be a long tether system. The initial tether system will be configured to perform electrodynamic experiments and will be deployed to a length of 20 kilometers. The deployment will require about eight hours and when deployed will operate in a variety of modes to support the specific experiments being performed. Since this is an electrodynamic tether, the tether line itself will be an electrical conductor. The tether will be retrieved at all times when not operating. The electrodynamic tether may be connected to the wave injector for use as a long antenna. The tether can be used to generate low frequency waves and to provide a path for electrical conduction during electron or ion accelerator operations. The tether can also be used as a collector of electrical power as the conducting tether line cuts through the Earth's magnetic field.

The recoverable plasma subsatellite (RPDP), although not connected directly to the manned space station, will fly in the vicinity of the station and will perform coordinated observations during campaign mode operations on the station. This subsatellite will also provide data on ambient particle and field conditions at the space station orbit at all times. Periodic servicing, reboost, and repositioning of the satellite will either be performed from the manned space station (using the OMV capability) or as a special function of STS logistic flights to the manned space station. The satellite will contain a full complement of particle and field instruments as well as selected imaging and photometer systems. Operational control and data flow will be primarily through the manned space station although back-up ground control is planned.

One STO instrument system is planned for placement on the space station co-orbiting platform - system to eject small probes (multiprobes). These multiprobes will contain diagnostic detectors or chemical/gas release canisters. (Other diagnostic plasma instruments could also be accommodated on the co-orbiting platform.) The ejectable probes are presently been designed to be contained in a single modular package containing multiple "throw away" rock class probes. Each probe will host three to four instruments designed to measure electric and magnetic fields, ion constituent densities and temperatures, electron density and temperature, energetic charged particles, and neutral density. The probes will be battery powered and will have lifetimes of a few days to months. They will be ejected to support campaign mode operations, monitoring the ambient environment at multiple points in the magnetosphere/ionosphere or supporting the active perturbation investigations by measuring the perturbation structure and propagation during accelerator firings and wave injections. A study is currently contemplated to include the capability for selected multiprobes to contain chemicals (CHEMSAT) which may be released to "paint" the magnetosphere for studies of magnetic field topology, the existence of magnetospheric electric fields, upper atmospheric winds, and critical velocity ionization. A set of twelve of these microprobes (8 diagnostic, 4 CHEMSAT) would be placed on the co-orbiting platform. Two of six of these probes would be ejected during, or immediately before, each of the STO operational campaign modes. Servicing missions to the co-orbiting platform will be required every six to twelve months to reload the package with a new set of probes.

The polar platform will contain the atmospheric monitoring instruments. These instruments will operate full time except for the photometric imager which can only operate at full capacity during the night portion of the orbit. These instruments will continually monitor the dynamics of the upper atmosphere aurora, and airglow, and profiles of atmospheric constituents. The compilation of this data is necessary to assess the long term variability of the Earth's upper atmosphere as a function of solar activity, solar irradiation variability and seasonal variability.

Measurements of aurora and airglow emissions provide information on excitations as a function of solar activity and magnetospheric activity. The photometric imager will provide imaging information on auroral forms and dynamics. The interaction of precipitating energetic particles into the Earth's upper atmosphere also provides information on the dynamics of the outer magnetosphere.

Spectrometers will monitor information from excited atmospheric species in the spectral range from 200 to 12000 A. From this data atmospheric composition may be monitored on a global scale. The doppler imaging interferometer provides information on atmospheric winds and temperatures in the mesosphere and lower thermosphere. The variation of this flow as a function of season and solar activity, when combined with information from the other atmospheric instruments, will provide better models of transport processes and energy coupling between the magnetosphere and the atmosphere.

A small accelerator system will also be flown on the STO polar platform. This accelerator will be used in a campaign mode similar to the active instruments on the manned station. It is envisioned that the accelerator instruments will be operated periodically to investigate parallel electric fields in the magnetosphere, for the creation of artificial aurora, and to perform magnetic field topology investigations.

The final STO instrument system to be flown on the polar platform at IOC will be the ejectable probes (multiprobes) similar to those planned for the co-orbiting platform. These probes will be primarily reserved for studies of high solar activity events, i.e. to gather data on the effects phenomena such as solar flares have on the magnetosphere/ionosphere. There will be a combination of both diagnostic probes and chemical/gas release probes (8 diagnostic, 4 CHEMSAT).

IV. THE PLAN FOR THE OPERATION OF THE SOLAR TERRESTRIAL OBSERVATORY

The STO is an event and comprehensive study-oriented combination of instruments with the goal of providing data to acquire a better understanding of the physical processes that couple the major regions of solar terrestrial space. The currently planned operational process to achieve this goal requires that near continuous monitoring of solar irradiance and solar active regions be established along with near continuous monitoring of atmospheric, ionospheric and magnetospheric constituents and dynamics. In order to better understand the processes which couple the earth-space regions, controlled, active experiments are planned which introduce perturbations that simulate or stimulate natural phenomena. These controlled experiments will be performed periodically during the STO mission and are referred to as campaign modes of operation. These campaign modes may be scheduled well ahead to perform a series of experiments to investigate specific physical processes. Alternatively, the campaign modes may be triggered by specific solar events which require experiments designed to investigate the evolution of naturally occurring processes. In this section we will attempt to provide examples of each type of these operational modes.

Some of the STO operational modes could be scheduled for times when the manned space station and the polar platform orbits converge on this same geomagnetic lines of force. Although this conjugate situation will only occur for a short time (seconds), the opportunity afforded for coordinated experiments between the manned station and the polar platform will be uniquely valuable.

Figure 1 shows an example of a typical campaign mode of operation. On average these times will be scheduled well ahead and the general experiment scenario will be pre-planned. Prior to the start of the campaign mode the electrodynamic tether will be deployed and the ejectable probe(s) will be released (from the co-orbiting and/or polar platform). The tether diagnostics will be operated for the full time that the tether is deployed, but the use of the electrodynamic mode operations will be performed in conjunction with the wave injector and the particle accelerators. Wave injection and particle accelerator operations will require some coordinated operations and some non-coordinated operations. For example, off-on modulation of the electron accelerator will generate waves which may be detected by the wave injector instruments. This would be an opportunity to perform coordinated investigations of the use of the electron beam as a virtual antenna. Likewise the wave injector using the high frequency sounding techniques is needed to detect and monitor ionospheric disturbances caused by the operation of the particle injectors. Numerous other examples of coordinated experiments involving the simultaneous operation of the wave injectors and the particle accelerators could be discussed. Typically the wave injector

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TYPICAL (NON SUN–EARTH EVENT TRIGGERED) STO CAMPAIGN MODE

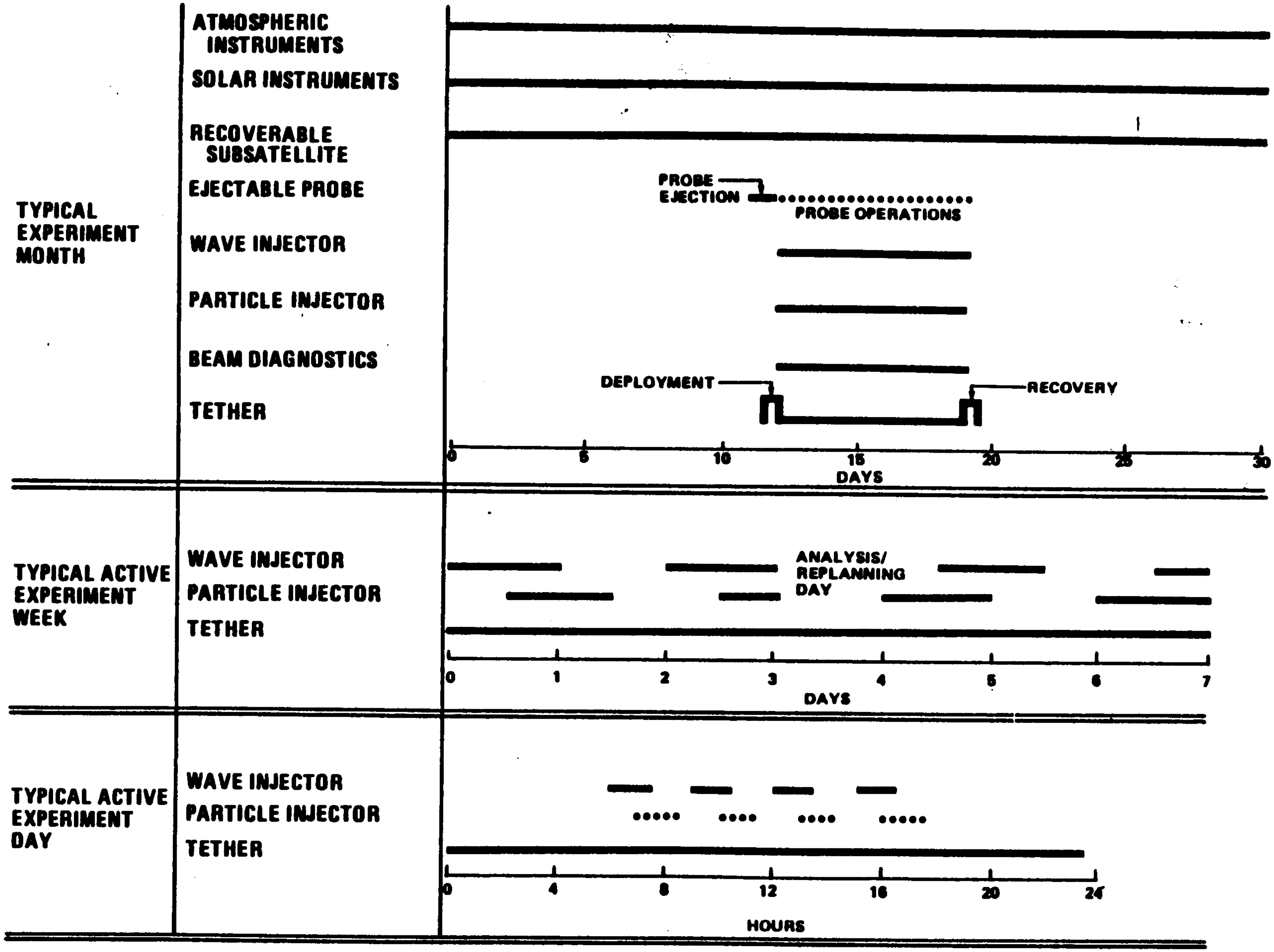

FIGURE 1

operations will have a duration of about one complete orbit (90) minutes whereas the typical duration for a particle injection experiment is about 5 minutes.

There are also classes of investigations in which the wave injectors and the particle accelerators do not want the disturbances caused by the other system. Time is therefore scheduled for WISP only, and for SEPAC only, operations.

During the week (7 days) of the typical campaign mode of operation, one day will be devoted to analysis of the data acquired to that time, and to accommodate any replanning necessary for the remaining time. Likewise the daily experiment operations will be planned to be accomplished within one 12-hour shift each day. This will leave adequate flexibility for the analysis and any required replanning for the following days' activities. This operational scenario has been derived as a result of our Shuttle/Spacelab experience which demonstrated the need for analysis and replanning time, and also demonstrated the loss of effectiveness of the flight and ground operations personnel resulting from shifts exceeding nine to twelve hours.

Figures 2 and 3 show examples of the second class of STO campaign mode operations - solar event triggered campaign modes. Both figures show that a particular type of solar event (i.e. a solar flare or coronal hole) is observed on the sun, and this triggers the subsequent operational scenarios. The solar instruments will be operated in a high data rate mode as will the atmospheric instruments. Data from other programs will also provide critical information during these times. Data from the International Solar Terrestrial Program (ISTP) satellites will be particularly important for solar wind and magnetospheric data. Data from the Upper Atmospheric Research Satellite (UARS) and the Earth Observing System (EOS) will also be very useful to determine atmospheric effects. Ejectable diagnostic and chemical release probes may be deployed from the polar platform or co-orbiting platform to aid in the investigations of particle and field effects in the magnetosphere/ionosphere system. Likewise the particle accelerators could be used to detect and investigate the occurrence of parallel electric fields. The wave injector would be very useful in mapping traveling ionospheric disturbances (TIP) resulting from the deposition of energy into the auroral zone and other sources.

These campaign modes, unlike the typical campaign mode discussed earlier, will require full operations 24 hours per day. This does not say that all instruments will be continuously operated, but rather that the operational scenario will accommodate single and coordinated operations of all the STO instruments and experiments 24 hours per day. In this way, the flight and ground crews will be available to perform detailed experiments and support continuous monitoring of the evolution of the natural events as they occur.

SOLAR TERRESTRIAL OBSERVATORY
SOLAR EVENT TRIGGERED CAMPAIGN MODE
SOLAR FLARE

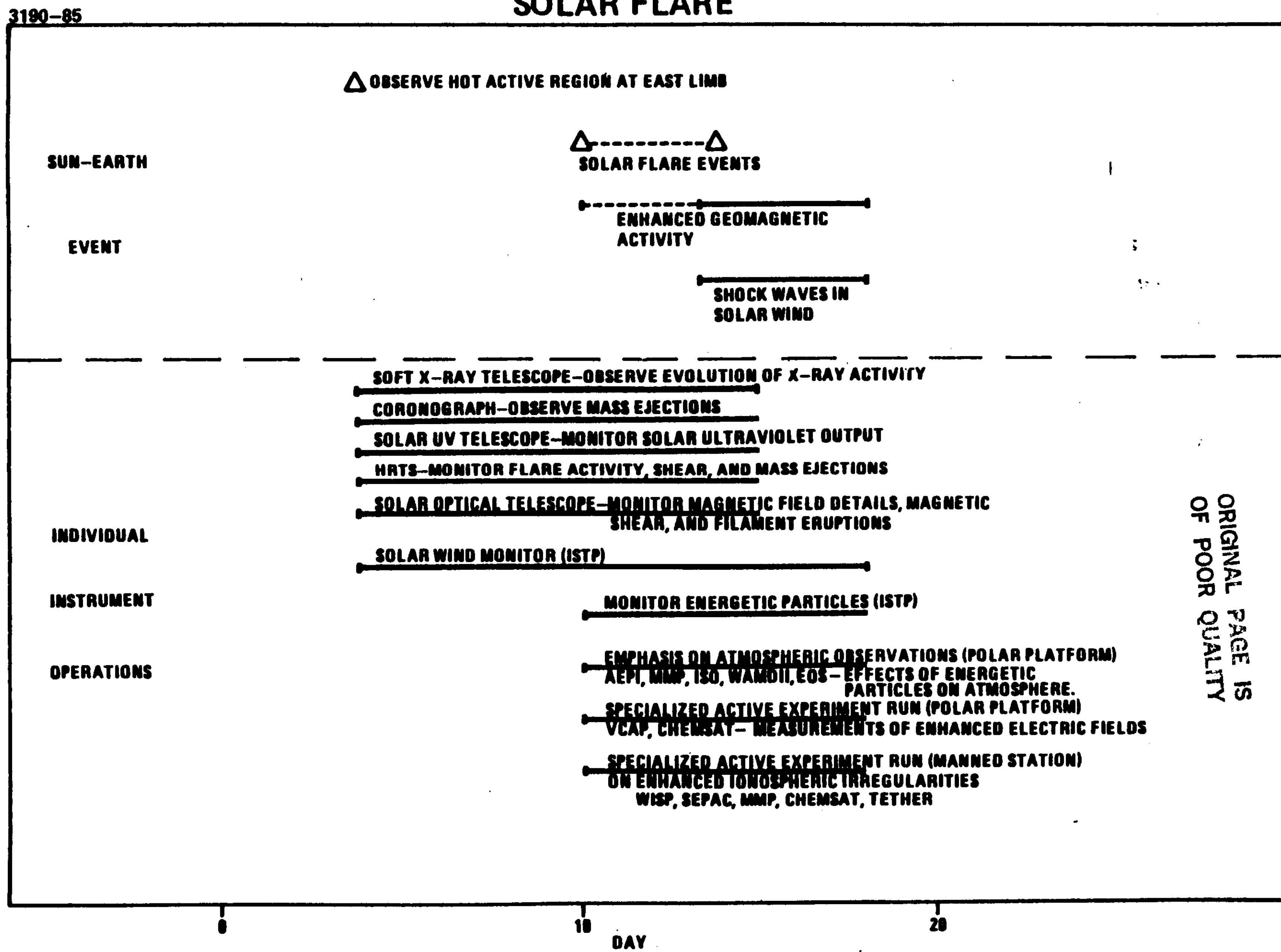

FIGURE 2

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SOLAR TERRESTRIAL OBSERVATORY
SOLAR EVENT TRIGGERED CAMPAIGN MODE
CORONAL HOLE

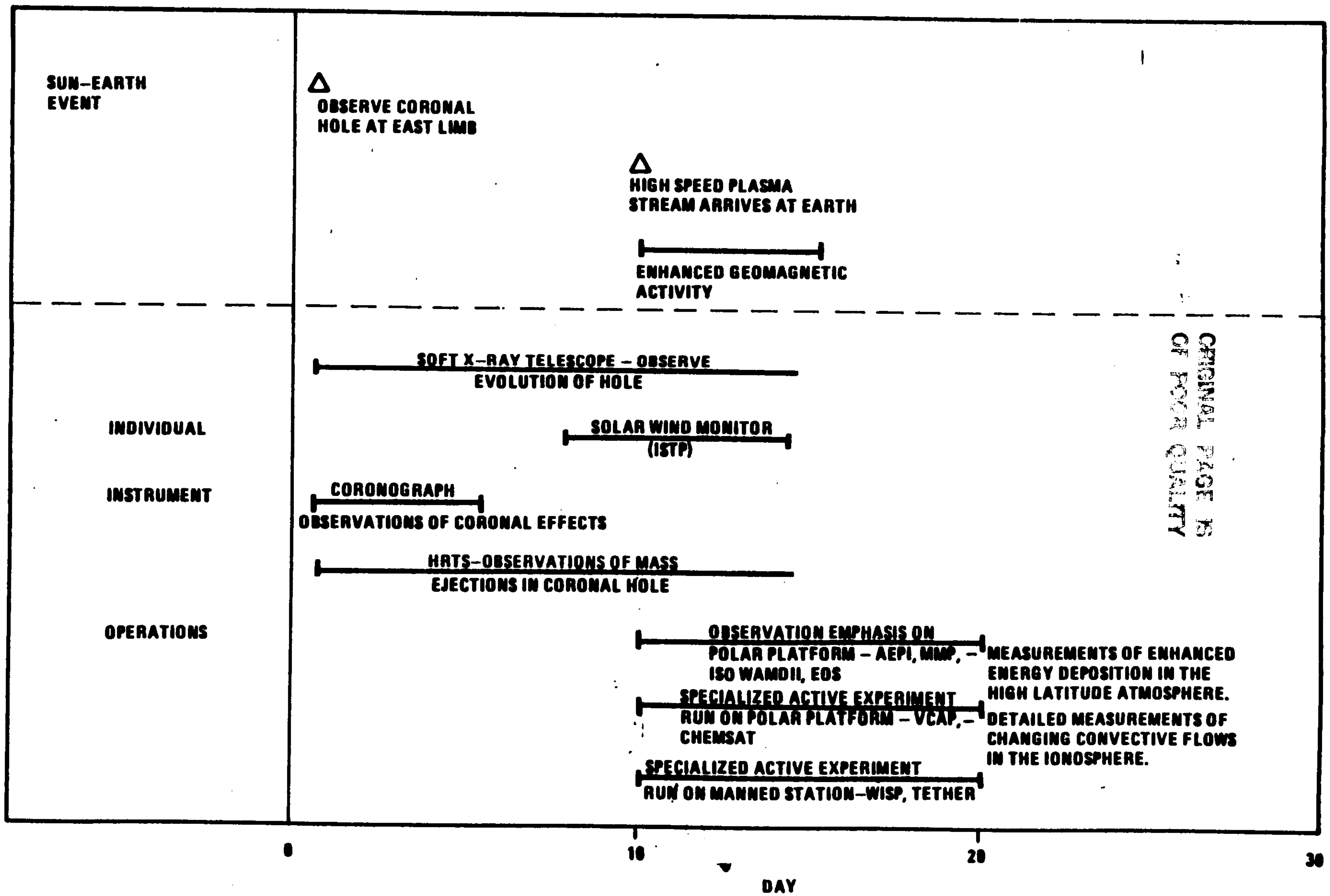

FIGURE 3

APPENDIX I

Appendix E

PROGRESS REPORT

COORDINATED STUDY OF SOLAR-TERRESTRIAL PAYLOADS ON SPACE STATION

NAG8-488

Period of Performance: February 1, 1986 - July 1, 1986

During the period of performance (February - July 1986) planning was made for a workshop of scientist and engineerings to meet to study the feasibility of implementation of STO (Solar Terrestrial Observatory) on Space Station.

Scientists and engineers met at The University of Alabama in Huntsville's University Center on June 24 and 25, 1986 to discuss scientific and programmatic issues concerning the Solar Terrestrial Observatory on board the Space Station. Specifically, they discussed payload requirements and service. The workshop was co-chaired by Mr. William T. Roberts of MSFC/NASA and Dr. S. T. Wu of the Department of Mechanical Engineering, UAH.

A copy of the agenda and attendees are attendees are attached.

Respectfully Submitted

S. T. Wu
Professor & Principal Investigator

Solar Terrestrial Observatory Workshop Agenda (2 Days)
University Center
Room 126

JUNE 24, 1986

9:00 - 9:10	Introduction, Schedule, Charge to Attendees	Roberts
9:10 - 9:15	Administrative Items	Wu
9:15 - 10:00	Space Station Overview	Sistilli
10:00 - 10:30	Attached Payloads	Holt
10:30 - 11:00	STO Science a) Science b) Availability of Instruments c) Science Operations	Taylor
11:00 - 12:00	STO Configuration	Kropp
12:00 - 1:00	LUNCH	University Center
1:00 - 1:30	Specific Assignments to Groups	Roberts
1:30 - 4:00	Group Meetings I	
4:00 - 4:45	Preliminary Summary and Identification of Issues	Group Leaders
4:45 - 5:15	Summary	
5:15	Adjourn	

JUNE 25, 1986

9:00 - 10:30	Group Meetings II	
10:30 - 11:15	Summary/Problem Report	
11:15 - 12:15	Ground Science Operations, - Conceptual Design - POCC/Central/Distributed - Mission Planning/Replanning - SS/PL OPS/Planning Interactions	Taylor
12:15 - 1:15	LUNCH	University Center
1:15 - 2: 15	Discussion - Required Instrument Modification/Upgrades - Identify Issues - Present Solutions If Reached - Identify Tradeoff or Other Studies that Can Be Done - Identify Action Items	
2:15 - 3:00	Summary	
	Adjourn	
3:00 -	Additional Discussions as Required	

Group Meetings Topics

- o Instrument Modifications and Upgrade Requirements

- o Comments on Presentations
  - STO Objective Complete?
  - Instrument Available?
  - STO Instruments Complete?
  - Science Operations Reasonable?
  - Placement Acceptable?
  - STO Instruments Compatible w/SS?

- o Instrument Requirements Correct?
  - Pointing
  - Servicing
  - Crew Involvement
  - Command Data Systems

- o SS Services
  - Power
  - Pointers
  - Cooling
  - Standard Interface
  - Data
  - Telemetry
  - Deploy
  - Contamination
  - EMI/EMC

Groups	Leaders	Assistant
Atmosphere	M. Torr	P. McShane
Plasma	J. Burch	B. Taylor
Solar	J. Davis	J. Kropp, S. Wu

SOLAR OBSERVATORY MEETING
JUNE 24 & 25, 1986
UNIVERSITY CENTER
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

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APPENDIX II

Appendix II.

COORDINATED STUDY OF SOLAR-TERRESTRIAL PAYLOADS ON SPACE STATION

NAG8-488

Semi-Annual Report

Period of Performance: August 1987 - February 1988

By

S. T. Wu, Ph.D.
Principal Investigator
Professor, Department of Mechanical Engineering
Director, Center for Space Plasma and Aeronomic Research
The University of Alabama in Huntsville

Submitted to

National Aeronautics and Space Administration
Marshall Space Flight Center
Marshall Space Flight Center, Alabama

March 1988

During this period of performance (August 1, 1987 - February 1, 1988) a meeting was held entitled The Second International Meeting on the Use of the Space Station for Research in Solar-Terrestrial Physics at the European Space Agency Head Office, Paris France on 21-23 September 1987. Travel support was given to Dr. George Carrigan of the University of Michigan, Dr. Steve Mende of Lockheed Palo Alto Research Laboratory to attend and participate in the discussions at this meeting.

The meeting was arranged by Dr. George Haskell of the ESA and co-chaired by W. W. Roberts of the NASA/MSFC. Thirty people from American, Canada and Europe attend this meeting. A list of participants and agenda is include as Appendix I.

Some of the highlights and future plans of the meeting are briefly summarized in the following:

Mr. A. Frandsen of the Space Physics Division/OSSA/NASA Headquarters gave a presentation concerning the OSSA/NASA point of view about STO planning priorities and strategies for the use of space station which can be stated as follows:

(i) Core station strategies
(ii) U. S. polar platform strategies
(iii) Attached payload investigation selection issues
(iv) Plasma interactions and effects working group
(v) SSPIE working group approach

Professor A. B. C. Walker of Stanford University gave a presentation concerning planning of the ASO. The important issues are:

(i) The configuration of the Advanced Solar Observatory
(ii) Scientific objectives which could be accomplished by ASO
(iii) Current status of ASO
(iv) Further development of ASO studies

Dr. Jack Kropp of TRW made a presentation on the study status of STO. Important subjects discussed were:

(i) Identify a set of typical solar terrestrial instruments
(ii) Derive specific accomendation requirements which these instruments will impose on space station.
(iii) Assess major operating parameters
(iv) Prepare approach to include international instruments.
(v) Develop concept for STO implementation on space station.
(vi) Estimate costs

Details of these subjects are published in a contract report entitled "Study Status" by TRW S & T Group, S/N 46652.000 submitted to MSFC in September 1987.

Mr. William T. Roberts of NASA/MSFC summarized the current status of STO/ASO. Because of the recent cancellation of some planned projects such as the Plasma Lab and SOT which resulted in severe impact on the planning of STO/ASO he pointed out the following in his presentation.

(i) Concerning STO
- o Meet all the P.I.s of the plasma group to reconstruct the program.
- o In early 1988, instrument implementation studies with P.I.s will be carried out.
- o Reform the science working group.

(ii) Concering ASO
- o ASO space station accommendation requirements study will be initiated.
- o Proposed definition studies on co-observing instruments will be started.

Professor S. T. Wu made a presentation concerning the international programs and some scientific objectives during 1987-1990 and 1990-1995 period sponsored by SCOSTEP (Scientific Committee on Solar-Terrestrial Physics). Dr. Wu is a bureau member of the SCOSTEP.

Dr. David J. W. Kendall of the Space Division, National Research Council of Canada gave a presentation of the Canadian position on the use of the space station for research in solar terrestrial physics.

Mr. Alan C. Holt of the Utilization and Operation Group/Space Station Program Office/NASA Headquarters gave a presentation about the activities and goals of the newly formed space station user integration division at NASA Headquarters.

Mr. B. Schmitz of CUPG/DFVLR, West Germany gave a presentation on the Columbus Phase B2 utilization study.

Dr. George Haskell of the ESA head office, discussed the space station science attached payload program stucture within the ESA. He stressed that the coordination between ESA and NASA needs to be enhanced in all aspects of the space station scientific utilization program.

Dr. C. Reading of ESA made a presentation on the ESA's program on Earth observation which has been considered as candidate for attached payloads on board space station.

Dr. Gerd Thomaschek of ESA/ESTEC presented ESA's CSTP operations status. In his presentation, he reported the present status of instruments, specific items, UOC concept and future activities.

During the three days discussion, we have concluded the following:

1. Coordination effects between ESA and NASA need to be enhanced. In particular, the joint A/O needs to be coordinated further.

2. Space Station user management structure needs to be determined.

3. Specific scientific objectives for space station need to be addressed. It is desirable to organize an international science working group to coordinate scientific instrument development.

4. An agenda for the 1988 science workshop will be organized by Dr. David Kendall Space Division/NCR of Canada.

5. A documentation concening STO on space station needs to be developed.

Respectfully submitted,

S. T. Wu
Principal Investigator

SECOND INTERNATIONAL MEETING ON THE USE OF THE SPACE STATION FOR RESEARCH IN SOLAR-TERRESTRIAL PHYSICS

21-23 September 1987

EXPECTED ATTENDANCE

EUROPE

CSTP Science Team

P. Bauer	Service d'Aéronomie, Verrières
C. Chaloner	Rutherford Appleton Laboratory
C. Hanuise	Université de Toulon
P. Maltby	University of Oslo
D. Ramsden	University of Southampton
D. Rees	University College London
P. Simon	Institut d'Aéronomie Spatiale de Belgique, Bruxelles
J. Stadsnes	University of Bergen

Invited Expert

K. Grossmann	Bergische Universität Wuppertal

ESA

D/SCI : H. Olthof, M. Coradini, G. Tomaschek, J.-P. Lebreton, S. Volonté, B. Andersen, M. Huber, S. Babayan (Administrative Assistant)

D/SSP : G. Haskell, G. Peters, J.-J. Dordain, R. Jönsson, S. Adamy-Guérin (Administrative Assistant)

D/EOM : C. Readings, I. Duvaux-Béchon

D/ESTEC : D. Kassing

D/TEL : G. Berretta, K. Galligan

CUPG

B. Schmitz
R. Henderson

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CANADA

D. Kendall	NRC, Ottawa

USA

A. Frandsen	OSSA/NASA HQ
J. McGuire / AL. Holt SSU	Space Station/NASA HQ
A. Walker	Stanford University
S. Mende	Lockheed
G. Carignan	University of Michigan
J. Kropp	TRW
W. Taylor	TRW
S. Wu	University of Alabama
W. Roberts	NASA/MSFC

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87-09-18

SECOND INTERNATIONAL MEETING ON THE USE OF THE SPACE STATION FOR RESEARCH IN SOLAR-TERRESTRIAL PHYSICS

21-23 September 1987

ESA Head Office, 8-10, rue Mario-Nikis,
Paris 15

Room 123 (Cinema)

DRAFT AGENDA

Monday, 21 September

09h30	WELCOME AND INTRODUCTION	H. Olthof
	SESSION I : ATTACHED PAYLOADS	(Chairman : H. Olthof)
10h00	Current Planning for STO	A. Frandsen
10h30	Current Planning for ASO	A. Walker
11h00	Break	
11h15	STO Study Status	W. Taylor/J. Kropp
12h15	Next Steps for STO/ASO	W. Roberts
12h30	Discussion	
13h00	Buffet lunch	
14h00	Columbus Phase B-2 Utilisation Study: Work Package 4000 (Attached Payloads)	B. Schmitz
14h30	Plans for Phase B-2 Extension	G. Haskell
14h45	Survey of Candidate Attached Payloads from Other Disciplines	C. Readings S. Volonté D. Kassing G. Berretta I. Duvaux-Béchon
15h15	Break	
15h45	Survey (continued)	USA Canada (D. Kendall)
16h15	Status of Small Attached Payloads Working Group	A. Frandsen
16h30	Discussion; Future Actions	
17h30	End of Session	
17h30	Cocktails (Floor 2B)	

Tuesday, 22 September

	SESSION II : PLATFORMS	(Chairman: W. Roberts)
09h30	Model Payloads related to STP on Polar Platforms	J.-P. Lebreton/W. Roberts
10h00	Discussion on complementarity	
10h30	Announcements of Opportunity	M. Coradini/A. Frandsen
11h00	Break	
11h15	Technical issues	
	- emc	C. Chaloner
	- on-line data processing	P. Bauer
	- contamination	D. Rees
12h30	Future Actions	
12h45	Use of EURECA-B	H. Olthof
13h00	Buffet lunch	
	SESSION III : PAYLOAD OPERATIONS REQUIREMENTS	(Chairman: M. Coradini)
14h00	CSTP Sub-Group Report	P. Maltby
14h30	Requirements Synthesis	G. Tomaschek
15h00	Break	
15h15	NASA View on STP Requirements	W. Roberts
15h45	AL. Holt Discussion; Future Actions	
17h00	End of Session	

7:00

Wednesday, 23 September

SESSION IV : SCIENCE THRUSTS (Chairman: M. Huber)

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09h30 Discussion: In the light of expected developments (STSP, theoretical advances, etc.) are we still on the right track with our plans for use of Space Station for STP ?

Introduced by:

S. Wu
P. Bauer
D. Rees
S. Mende

11h00 Break

11h15 Discussion (continued)

SESSION V : CONCLUSIONS AND FUTURE ACTIONS (Co-Chairmen: M. Coradini/A. Frandsen)

12h00 Agenda to be set up in response to discussion, but including:

- Space Station user management structure
- input to IFSUSS (November, La Jolla) International Forum on the ~~ut~~ scientific ~~uses~~ utilization of space station
- drafting of summary report
- future actions

13h00 Buffet lunch

14h00 SESSION V (continued)

15h00 Break

17h00 End of Meeting.